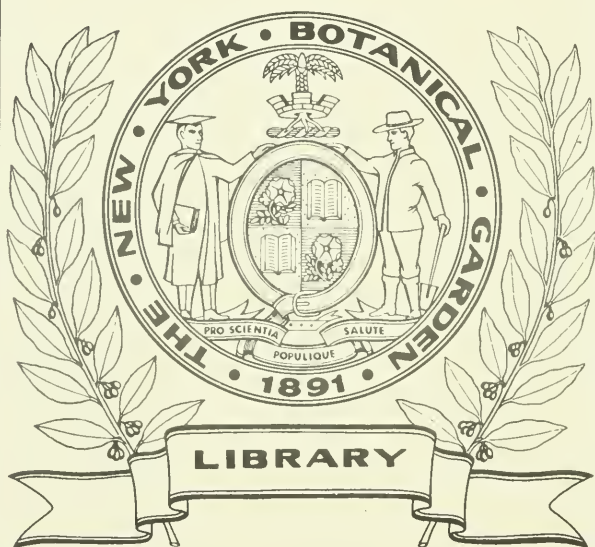


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Griggs, Robert Fisks

A botanical survey of the sugar
grove region

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OHIO BIOLOGICAL SURVEY

BULLETIN 3

A Botanical Survey of the Sugar Grove Region

BY
ROBERT F. GRIGGS

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OHIO BIOLOGICAL SURVEY

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REVIEWS

Grigg's Botanical Survey of the "Sugar Grove Region," Ohio *

This paper is a good description of an area which is seldom mentioned in phytogeographical literature, though of exceptional interest and located in one of our most thickly settled states. An 11-page introduction treats of the geology, topography, soils and climate, and there are 37 pages on the vegetation ("ecology"), 6 on economic aspects, and 36 on the flora. The illustrations are excellent half-tones of scenery, vegetation, or single species of plants, most of them apparently never published before; but they are not dated, so that the reader can only guess at what season they were taken from the appearance of the foliage or flowers.

The area has no very definite boundaries, but is located in Fairfield and Hocking counties, a little southeast of the center of Ohio, in the unglaciated Carboniferous plateau region that extends from Pennsylvania to Alabama. (Some of the illustrations could be matched pretty closely in the coal region of Alabama.) The topography is very broken, though hardly mountainous. (Many readers will doubtless be surprised, as the reviewer was, to learn that there is such rugged topography in Ohio, for much of the surface of that state is very flat.) The soils are mostly derived from sandstone, and therefore deficient in basic materials. The nature of the soil and topography has retarded agricultural development, and thus allowed this area to remain one of the best "botanizing grounds" in the state.

The average growing season is 155 days, the average annual snowfall 25 inches, and the rainfall (from 35 to 40 inches a year) is pretty evenly distributed through the seasons, but with a slight excess in the summer months. In this last particular this locality resembles many other places with somewhat sandy soils,† and differs from most places in the Ohio valley.

* A botanical survey of the Sugar Grove region. By Robert F. Griggs. Ohio Biol. Surv. Bull. 3, or Ohio State Univ. Bull. vol. XVIII (18), no. 25, or Contr. Bot. Lab. O. S. U. no. 84. 98 pp., frontispiece, 29 numbered text-figures, and full-page map. "April" 1914 [or rather August, according to a letter from the author]. (The pages are numbered from about 247 to 340, but an examination of Bulletins 1 and 2 of the same series leaves one in some doubt as to the title of the volume to which the pagination belongs.)

† See Geol. Surv. Ala. Monog. 8: 24 (footnote). 1913.

The descriptions of vegetation cannot be adequately summarized in a brief review, but must be seen to be appreciated. For each of the habitats, about fifteen in number, the environmental factors are described in a general way, and the commoner plants listed (usually about one third of the vascular species and sometimes a few mosses and lichens), usually in approximate order of abundance or conspicuousness, but often disconnectedly, and with a somewhat arbitrary distinction between dominant and secondary species. At the beginning of most of the habitat lists the names of one or two species regarded as dominant are printed in small capitals; the rest being in italics. (The method of treatment is not very well explained in the paper itself, but some of the facts given in this paragraph have been obtained subsequently by correspondence with the author.)

Some valuable original suggestions are made about the critical environmental factors for certain species, but some of these do not seem to hold throughout the ranges of the species. For example, on pages 270 and 283 it is stated that *Betula lenta* requires a constant supply of water near the surface. But in Massachusetts, New York and Michigan it grows in ordinary "mesophytic" upland woods, and at its southern limits in the mountains of Georgia and Alabama it is chiefly confined to exposed cliffs at high elevations (often with *Kalmia latifolia*). On page 283 *Kalmia latifolia* is said to be "preëminently a sun-loving plant"; but it grows in dense shade always in Florida, often in North Carolina, and sometimes in Massachusetts. (For both of these species protection from fire is probably a more important factor than soil moisture or insolation.)

Very interesting is the suggestion on pages 283-286 and 290-292 that evergreen herbs are confined to places where they are not crowded by other plants or liable to be smothered by falling leaves. It has seemed to the reviewer, however, that such herbs are especially characteristic of soils poor in potassium and pretty well protected from fire* (this is especially manifest in the case of epiphytes, all of which seem to be evergreen†); but at the same

* See Bull. Torrey Club 38: 517. 1911; 41: 214-217. 1914.

† See Ann. N. Y. Acad. Sci. 17: 38. 1906.

time the volume of annual leaf-fall is likely to be least in the poorest soils, *ceteris paribus*,* so that the dead-leaf hypothesis is not disproved. (And epiphytes are naturally just as exempt from smothering by leaves as they are from fire and overfeeding.)

The flora is pretty rich: 972 species of vascular plants being listed. This includes quite a number which have not been seen there by botanists now living, but the mosses and lichens mentioned in the ecological part are not enumerated in the taxonomic part. Most of the species in the catalogue are not referred to any habitat, which seems an unfortunate omission in a work which is so largely ecological. On the other hand, a few of the vascular plants mentioned in the descriptions of vegetation (just how many it is difficult to determine without an index) are not mentioned in the catalogue; but such omissions may be wholly the fault of the printers.

Nearly all the species in the catalogues are given "common" names, fictitious ones being used where no bona-fide ones have been discovered. Most but not quite all of the specific names are decapitalized. Over 15 per cent. of the technical names, and a few other words, are misspelled, many of them more than once or with more than one letter wrong.

From the summary at the end of the catalogue it appears that 22.7 per cent. of the angiosperms are monocotyledons: a figure agreeing pretty well with those for other unglaciated parts of the Paleozoic region of eastern North America.†

One of the objects of a review is to point out the good and bad features for the benefit of those who may undertake similar work afterwards (and there ought to be many more papers of this sort for other parts of the world). Among the good features of the work under consideration are the satisfactory descriptions of physical features, especially climate, the excellent illustrations, the careful classification of habitats, the amount of space devoted to environmental factors, the arrangement of species in order of abundance in the habitat lists, and the accurate identifications of species (a matter with which the Ohio botanists seem to be more

* See Bull. Torrey Club 40: 399. 1913.

† See Torreya 5: 207-210. 1905.

particular than some others are). Most of the shortcomings are not peculiar to this paper by any means, but are merely manifestations of widespread modern tendencies, due largely to excessive specialization in education and a growing indifference to matters not directly in one's line; and for some of them the author can hardly be held responsible at all. Others are points which will probably be given more attention in the future than they have in the past. The principal ones are:

Using too many different serial numbers on cover or title-page, one of them Roman (a sort of notation which has outlived its usefulness).

Dating the publication falsely, and thus working an injustice to any one who may have published something similar between the alleged date and the real date. Omitting dates from illustrations (where they are just as useful as on herbarium labels, etc.).

Carelessness in spelling and proof-reading.

Using the terms "region" and "ecology" too loosely.

Too few comparisons with other parts of the world and citations of previous literature.

Insufficient explanation of the methods of treatment.

Too little correlation of vegetation with soil.

Lack of quantitative figures for vegetation.

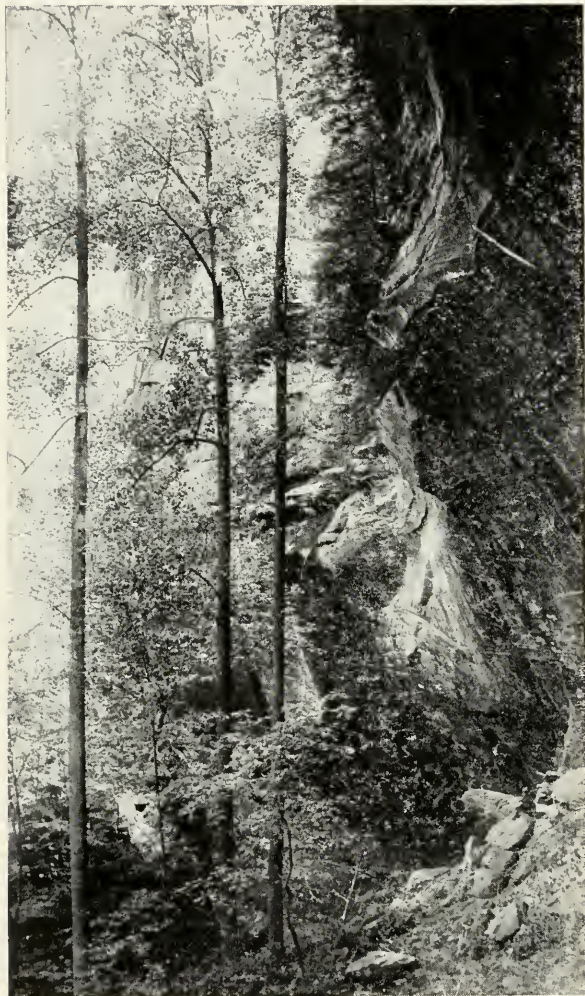
Assuming that species treated as native in floras of the northeastern United States must be indigenous in every part thereof, even where the habitat indicates otherwise.

Too great discrepancy between ecological and taxonomic parts, in number of species included.

Using fictitious common names, which appear to serve no useful purpose, and take up space which might be better occupied with information about habitats or other significant facts.

Decapitalizing specific names, and thus obliterating certain interesting etymological distinctions without benefiting the reader appreciably.

ROLAND M. HARPER



A *Liriodendron* Cove
(The figure gives the scale.)

—Photo B. B. Fulton.

VOLUME 1

BULLETIN 3

OHIO BIOLOGICAL SURVEY

A BOTANICAL SURVEY OF THE SUGAR GROVE REGION

By
ROBERT F. GRIGGS

Published by
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A BOTANICAL SURVEY OF THE SUGAR GROVE REGION

By Robert F. Griggs

INTRODUCTION

The Sugar Grove region is a narrow strip of country extending from a few miles north of the town of Sugar Grove in Fairfield County, Ohio, in a southerly direction about twenty miles to the valley of Queer Creek near the southern boundary of Hocking County, thus occupying parts of the Lancaster and Laurelville quadrangles as mapped by the U. S. Geological Survey. It has been denominated the Sugar Grove region in this paper not because the various plant societies which distinguish the area reach their climax at Sugar Grove but because that is the only railroad station lying immediately in the region. The country in the vicinity of this village has long been known among the botanists of Ohio as the richest collecting ground in the state with the exception, perhaps, of the region around Sandusky.

In its general relations the flora may be described as an outlier of the great Allegheny mountain flora from which it derives a considerable number of Appalachian plants, like the great *Rhododendron*, which do not occur elsewhere in Ohio. Besides these plants there are a number of others, like the *Lycopodiums*, which belong in the Canadian area and come into Ohio from the north, reaching their southern limits, so far as Ohio is concerned, in the present area. In addition to these there is a third element of southern plants such as *Aralia spinosa* which stretch up from Kentucky and Tennessee and reach their northernmost limits in this region. These elements conspire to make the region interesting and to give a very large proportion of the flora that quality of "rarity" which is so dear to the heart of a collector.*

While the Sugar Grove area is rather definitely delimited by the physiographic features about to be described, its principal plant associations are not at all limited to its confines. With slight modification they cover much of the hill country in southeastern Ohio and parts

*These relations have been discussed in detail by the writer in two papers, as follows: Observations on the Geographical Composition of the Sugar Grove Flora. Bull. Torr. Club, 40: 487-499, 1913.
On the Behavior of Some Species on the Edges of their Ranges. ibid 41: 25-49, 1914.

of Pennsylvania and West Virginia as well. The descriptions here given may be applied, therefore, in a general way to the whole of this country, gradually becoming less and less applicable as the distance from Sugar Grove increases and new elements come in to affect the plant covering. This particular area is, however, better adapted to serve as a type of the whole hill country than any other which could be selected within the state of Ohio. The reason for this lies in the greater ruggedness of the country which operates in two ways: first, it is only in a country with high cliffs and deep ravines that the climax associations, both mesophytic and xerophytic, which characterize this territory can develop; and second, the very roughness prevents the agricultural utilization of the country and retards clearing so that here one finds a much larger proportion of unspoiled forest than in any of the country round about.

The causes which led the writer to undertake the present work were: first, interest in collecting over the region itself; second, a belief that an account of the flora would be of service to those who are studying the geographical ranges of the plants of North America; third, a desire to present some account of its ecology which might be useful to phytogeographers in general, such studies of the Alleghenian region being at present rather few and far between; and finally, a recognition of the fact that the portable sawmill is devastating the forest so rapidly that only a few years hence it will be impossible to reconstruct for the service of posterity a picture of the aboriginal condition of the country. Indeed, some of the associations which are here described have been already obliterated and it would be impossible now to duplicate this account.

Geology and Physiography. The physiography of the country resembles in a general way that of the hill country found over all of southeastern Ohio and much of West Virginia. It is a rolling upland cut up with numerous deep ravines giving a total relief of from three to four hundred feet.

The shape and boundaries of the Sugar Grove region are determined, except on the north, by the area of maximum outcrop of a heavy sandstone of carboniferous age, the Blackhand conglomerate, which weathers out in high cliffs around every little ravine. That the greatest exposures of sandstone should be limited to so small an area is due principally to the stratigraphic peculiarities of the sandstone which in turn are bound up with the history of its disposition. The various



Fig. 1. A Waterfall in the Hemlock Forest.
Queer Creek.

The man (near the top) gives the scale.

factors are too complex for detailed presentation here, and indeed have not been at all understood by geologists until recently when they have been worked out by Dr. J. E. Hyde for the Geological Survey of Ohio. The writer had the good fortune to have the company of Mr. Hyde on several field trips during which he obtained a considerable amount of information as yet unpublished which has helped him greatly toward an understanding of the geology of the country. Suffice it to say that the heavy sandstone is an old delta with all the peculiarities of cross bedding and local cut and fill usually found in such deposits. Conditions of deposition have also been such as to accentuate and apparently increase the easterly dip of the strata which is general over all of central Ohio. On the eastern edge of the area the sandstone thins out and is carried under cover so rapidly that the character of the country changes greatly within short distances, as for example between Little Rocky Branch (Lanrel Township) where the cliffs are so high as to prevent lumbering, and Rocky Branch only a mile away where they are low enough to permit clearing and pasturing. On the opposite edge of the area about four miles to the westward on the other hand, the conglomerate becomes simply a capstone on the tops of the hills, which are further and further apart until the bottom-lands between them are large enough to have made tillage profitable with the consequent destruction of the natural vegetation. The highest cliffs occur in the canyon of Queer Creek near the southern edge of the area where in one place nearly 190 feet of rock are exposed. (fig. 1) South of this point the sandstone thins out rapidly so that the character of the vegetation undergoes a distinct change within a mile or two. On the north occasional outcrops of the sandstone occur far beyond our area but the physiognomy and plant covering of the country are decidedly modified by the presence of a sheet of glacial drift of Wisconsin age, the terminal moraine of which marks the northern boundary of the region.

The area lies therefore wholly below the boundary of the glacial drift, and its soils, except the bottom lands of the largest streams, are entirely residual derived from the decay of the several rocks underlying the land.

The order of succession and approximate thickness of the formations which are exposed within the area are shown in the subjoined table for which I am indebted to Prof. W. C. Morse who has kindly loaned me his field notes containing numerous sections taken from exposures in and adjoining our area, from which I have constructed

the generalized table given. The rocks are all derived from shallow water deposits and like most other such strata vary greatly in thickness and lithological character within short distances. No single section corresponding to the table could therefore be found, but the data given are sufficiently accurate for the purposes of this paper.

GEOLOGICAL FORMATIONS

Pottsville.

85'	10'	Blue arenaceous shale.
	3"-18"	Coal (Probably the Quakertown Coal, No. 2). Formerly worked at the head of Laurel Run for local consumption.
	20'	Argillaceous shales and sandstones with some fire clay.
	30'	Massive coarse-grained sandstone (the Sharon), but cemented so loosely as seldom to form surface rock.
	20-30'	Thin-bedded sandstones with some impure fire clay and coal blossom.

Logan formation.

45'	Thin-bedded sandstones with argillaceous or arenaceous shale partings, some strata of impure nodular limestone.
-----	---

Black Hand Conglomerate. (Upper portion of Cuyahoga formation),

200'	A single conglomeritic sandstone or several, usually two, heavy sandstones separated by intervals of argillaceous shale.
------	--

Cuyahoga formation (proper)

500'	Sandstones, mostly thin-bedded, and shales. The top of the formation is exposed in a few places in our area.
------	--

Except for the Black Hand the rocks are seldom exposed except in the bottoms of the ravines and in artificial excavations such as roadside ditches. Their physiographic features therefore require no special mention, but the peculiarities of the weathering of the Black Hand have a large effect on the physiography and the vegetation of the country. When first quarried this stone is very friable, but on exposure it becomes hard and durable. Thus it often happens that the exposed top of a cliff becomes much harder than the protected portion which weathers away more rapidly, forming an overhang. The "caves," as they are popularly called, so formed are very numerous and some of them are very extensive, when the method of their formation is considered. The most interesting are favorite places for picnics and a few of them have acquired more than a local reputation. Ash Cave is the largest, being nearly 700 feet long with an overhang of about 60 feet and a height at the waterfall of 84 feet. Old Man's

Cave (fig. 22) is not so large but is higher, more beautiful, and more interesting to a botanist. In Cantwell Cliffs the cave is almost hemispherical with a narrow ledge half way up where one finds acoustic properties that are little short of marvelous. More celebrated than any of the others and more remarkable from a physiographic point of



Fig. 2. The Interior of the "Rock House."

view is the Rock House (fig. 2). This was formed by the accentuation of processes often seen in lesser degree throughout the region. In this case the rock crumbled back along the moisture-laden joint planes till the soft interior was exposed and in turn crumbled along a joint plane parallel to the face of the cliff until there has been formed a corridor about 200 feet long which runs along behind a series of six

columns, the remains of the original face of the cliff, which support the vaulted roof.

Some of these caves afford exceedingly moist habitats with water dripping from the rock in abundance and an atmosphere laden with moisture to near the point of saturation. Others exposed to the sun are extremely dry, being sheltered from all rainfall and kept thoroughly dried out by daily insolation.

Soil. No detailed study of the soils of the region has ever been undertaken, but it may be desirable to indicate briefly the general character of the principal soils met with in the area. Except for the rich bottom land of the Hocking River, all of the soils, bottoms as well as uplands, are derived from the disintegration of the sandstone rocks of the area, and are therefore deficient in basic materials. There is much variation in the physical character of the various soils depending on the relative amounts of arenaceous and argillaceous constituents present. In the deep ravines under the cliffs the soil often consists of almost pure sand. Such soils are so loose and porous that the abundant organic remains they contain do not humify but are rapidly and completely oxidized without enriching the soil to any great extent. The soils derived from the formations above the Black Hand, on the contrary, have a considerable amount of clayey material which gives them a decidedly sticky consistency when wet, but they dry easily, and except when very wet would be classed as light rather than heavy. Between these two extremes there is naturally every intergradation, depending on the degree to which constituents from the two principal rocks have entered into the soil of any given situation. While there are other soils more or less widely distributed over the area these two types with their intergradations cover so large a proportion of it that they may properly be said to constitute its soil.

The soil must be classed as poor from an agricultural point of view. The bottom lands, except for the rich Hocking bottom, are not very generally utilized. They are mostly too narrow for successful cultivation and their soils are generally so light and sandy as to be difficult to manage profitably. On the uplands wheat is the staple crop but it is difficult to secure a proper rotation since corn and clover do not thrive on account of the prevalence of soil acidity. The greater part of the land is so subject to wash, either from floods or from surface run-off, as to be continually menaced whenever the sod is broken up for cultivation.

Climatology. Those features of the meteorology which go to make up the climate have been compiled and published by J. Warren Smith¹ in a report covering the state of Ohio as a whole and earlier as Section 71, South-central Ohio (1910) in the general summary of climatological data for the United States. It is from the introductory matter of the latter report, as more specifically describing conditions in our area than the general bulletin, that the direct quotations given below were taken.

No records have been taken within the area itself but the data given for surrounding towns, since they are reasonably concordant, give, it is believed, an accurate idea of the larger climatic features affecting vegetation. The stations selected are: Lancaster, about five miles north of the area with a record twelve years in length, from 1896 to 1908; Logan, about 10 miles east of the area, with records for sixteen years, from 1884 to 1900; Cireleville, about 15 miles west of the area, with records of twenty years, from 1888 to 1908; McArthur, about twenty miles to the south, with records for the five years from 1894 to 1899, and parts of three additional years; while the observations of the regular Weather Bureau station at Columbus, thirty-five miles northwest, with records extending back to 1878, have been used for comparison.

The monthly mean temperatures in degrees Fahrenheit of those stations whose records are available are as follows:

MONTHLY MEAN TEMPERATURES

	Yrs. of Record	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Growing Season Ap. to S.
Lancaster . . .	13	30.2	28.2	42.0	50.5	62.3	69.1	74.0	71.7	66.5	54.0	42.2	32.3	51.9	65.7
Cireleville . . .	14	30.2	28.1	43.3	51.8	63.2	70.7	75.3	73.3	68.0	54.9	42.4	32.7	52.7	67.0
Columbus . . .	31	28.9	30.1	39.6	51.1	62.5	71.0	75.2	72.7	66.9	54.7	41.8	32.7	52.2	66.6

The highest and lowest temperatures ever recorded are 102° and -21° at Cireleville, 99° and -21° at Lancaster, 104° and -20° at Columbus. The highest temperature is usually reached in July, but August is nearly as hot. The lowest temperatures are sometimes reached in:

1. Smith, J. Warren. The Climate of Ohio. Bull. O. Ag. Ex. Sta. 235:185-209, 1912.

January and sometimes in February. The data do not include, however, the extremely hot summer of 1911, nor the exceptionally cold winter of 1911-12. The extreme temperatures recorded for the middle section of the state, 108° and -34° , will perhaps give a better idea of what may be expected for the absolute extremes in our area. These are of course important because of their destructive effect on vegetation which would tend to control the southern limits of certain species and the northern limits of others and so react on the composition of the flora.

The average date of the last killing frost in spring is April 30, of the first killing frost in the autumn October 2. The average growing season is therefore about 155 days in length. But the latest killing frost reported was on May 30, and the earliest in autumn about September 15, giving a minimum growing season, if both late and early frosts should occur in the same year, of only 110 days. But the frost data have not been taken for a long enough period at any of the stations under consideration to give reliable data as to possibilities in this direction. "On June 5, 1859, a killing frost occurred in the central and northern part of this section [i. e. Sec. 71] that is still known as the great June frost."

"*Precipitation* is quite uniform over the whole of the section [in which our area is located] and averages about 38 inches (95 cm.) per year. At North Lewisburg in Champaign County the smallest annual rainfall in a period covering 56 years was 23 inches (57.5 cm.) in 1872, and the greatest 58 inches (145 cm.) in 1852," while at Cincinnati in a record from 1835 to 1908 inclusive, the least was 17.99 inches (42.5 cm.) in 1901 and the greatest 65.18 inches (163 cm.) in 1847. "The distribution of the rainfall is fairly uniform, as will be seen from the table given herewith." "In general there is the greatest average rainfall in June and July, and the least in October. There are very few months with less than an appreciable amount of precipitation in all parts of the section, and monthly falls of over 10 inches (25 cm.) are not very frequent. The greatest monthly fall reported at any of the stations under consideration is 15.90 inches (40 cm.) at North Lewisburg in September, 1866," while at Carthegena, Mercer County, 17.33 inches (43 cm.) fell in June, 1877. Although these stations are at considerable distances from the area under consideration, their records will give a fair idea of the maximum precipitation to which its vegetation would be subjected in a long series of years. This extreme maximum is of

importance because of the destructive effects of the floods, which would fix the boundaries of the flood-plain associations subject to inundation and prevent permanent encroachment upon these associations by the plants of higher ground which could not endure the flood.

AVERAGE MONTHLY RAINFALL (INCHES)

	Yrs. of Record	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Lancaster	12	2.90	2.67	4.73	2.97	4.31	4.64	4.58	2.88	2.13	1.93	2.73	3.15	39.62
Logan	16	3.54	3.92	3.27	2.86	3.51	4.31	4.19	3.63	2.94	2.31	3.38	2.64	40.50
Circleville	20	2.69	2.67	3.61	2.73	3.60	4.09	3.94	3.14	2.28	2.17	2.64	2.40	35.96
McArthur	5	3.12	3.55	3.69	2.49	3.69	3.56	4.31	3.01	2.45	1.72	2.93	2.91	37.43
Columbus	30	2.97	3.01	3.49	2.84	3.80	3.41	3.65	3.21	2.41	2.32	2.91	2.66	36.68

The average snowfall is very close to 25 inches (62.5 cm.). The configuration of the land is such that the snow is generally blown or melted off the uplands, leaving them bare and exposed for the most of the winter. The depth of the annual snowfall is an insignificant factor in such situations, but in the deep ravines the drifts accumulate and keep them cold and wet well into the spring, affording thereby suitable habitats for the many northern plants, which here reach their southern limits. Single snowfalls exceeding 8 inches (20 cm.) are not common, but there is a record of 30 inches (76 cm.) at Lancaster during April, 1901. At Columbus 13.5 inches (39 cm.) is the greatest amount of snow ever reported upon the ground at one time. The greatest annual snowfall of record is 67.8 inches (170 cm.) in the winter of 1909-10, while the smallest is 8.5 inches (21 cm.) in the winter of 1896-7. Snowfall is usually confined to the months from November to April, but "appreciable depths of snow sometimes occur in May and October."

"The average number of rainy days is 106. The average number of clear days is from 125 to 150, and the average number of cloudy days is about the same. At Columbus the average annual sunshine is 54% of the possible amount; the average number of clear days is 103, partly

cloudy 131, and cloudy 131. The average number of days with thunderstorms at Columbus is 33."

The prevailing winds at Columbus are southwest and the average movement of air is eight miles per hour. Tornadoes are rare, but storms violent enough to destroy many trees are of periodical occurrence. The records of the Weather Bureau show that during the years 1892-1901, when the observing station was located in a comparatively low building, there averaged 3.4 days per annum with winds reaching



Fig. 3. Over the Upland Between Big Pine Creek and Queer Creek.
Timber remains only in the ravines.

or exceeding 40 miles per hour. But from 1903 to 1911, after the observatory was moved into a "skyscraper," the average number of days with gales rose to 26.5. The absolute maximum is 70 miles per hour on March 15, 1908.

The mean relative humidity at Columbus is as follows:

	January	February	March	April	May	June	July	August	September	October	November	December
7 a. m.	84	82	80	74	75	77	76	79	80	81	82	73
7 p. m.	77	74	69	61	61	63	59	61	62	64	70	76

On the longest days of the year there are about 15 hours of sunshine from sunrise to sunset.

ECOLOGY

As in all dissected countries the area is to be divided primarily into lowland and upland (figs. 3, 4 and 5). These two divisions form the basis of the human society which occupies the territory. There are lowland farmers and upland farmers; each community has its own set of roads and travel tends to stay down if following a valley road and to



Fig. 4. "Kunkle's Hollow,"
Upland and Lowland Forests.

Oak forest on the more sheltered west hillside (left) and pine forest on the more exposed east clifftop (right), *Liriodendron* forest in the ravine.

keep up if on a ridge road. The plant covering likewise is to be divided primarily into lowland and upland forests, each of which is naturally sub-divided into its component associations. In the case of both lowland and upland forests, it will be most convenient to begin the description with the extreme types and proceed to the less extreme, finally describing the intermediate associations which mark the transition from lowland to upland.

THE BOTTOM LANDS

Of all the problems that confront one who is attempting to find out the aboriginal condition of this country, none is so difficult as the reconstruction of the vegetation of the bottom-lands along the large streams. There is not a vestige left to suggest the original condition

of the Hocking bottom between Lancaster and Logan except the swamps described below and a few large trees standing in the fields into which it has been converted (fig. 6). Many of these, however, have either come up from seed since the forest was cut off or were very young at that time, for they show no traces of ever having been crowded by near neighbors. One of them, a sugar maple (*Acer. saccharum*), known as "The Queen of the Valley" (figs. 6 and 7), is the most perfect specimen of a round-topped shade tree known to the writer. Whether this bottom-land was originally covered with associations similar to those of rivers in other parts of the state or whether it partook of the features of the mixed forest of the "coves" cannot now be determined. Farmers who with their parents before them have always lived in the valley know nothing of the time when the land was generally clothed with forest. The last



Fig. 5. The Hocking Valley at Sugar Grove.

The hillsides still forested and largely in their natural condition, lowland and upland both cleared and cultivated.

vestige of the forest, a little patch of only a few acres, was cleared away, so the writer is informed, about fifteen years ago. It is said to have contained some very large sycamore trees, with an admixture of some other species.



Figs. 6 and 7. The "Queen of the Valley."
A Sugar Maple in the Hocking Bottomland.
—Photo by J. E. Hyde.



Fig. 8. *Blephariglossis paramoena* Growing in a Weedy Bottomland with Mixed Vegetation in which *Agrimonia* is Prominent.

Even when themselves undisturbed, no other associations show so quickly the effects of the changes in the land around them as the bottom-lands. The periodical freshets are very efficient carriers of seeds from place to place. It is obvious that any change in the vegetation at one place will change the character of the seeds carried down stream into other unchanged societies. In the original condition of the country the seeds thus brought in by the freshets would represent largely

species already present, and the ensuing struggle between the seedlings, whatever might be its result, would not affect the composition of the association. If the new plants which appear on clearing had to struggle simply against the established association, they might not be able to gain a foothold. But with the very changes which supply different kinds of seeds there comes an unsettlement of the societies already in possession. The floods become much more destructive and uproot large patches of the original vegetation. In this way a place is prepared already cleared for the invaders and they are no longer handicapped, but compete at an advantage over the original inhabitants of the soil. This condition is noticeable in the brooks as well as the rivers in an area like the present, where the uplands are cleared down to the fall line and used for agricultural purposes, while the ravines are left in timber.

THE BOTTOM LAND SWAMP

Perhaps the clearest indication of the original condition of the Hocking bottom land, except for the very bank of the stream, is (or was, prior to 1912, when it was lumbered) given by a small swamp in the N. E. $\frac{1}{4}$ of section 4, Berne Twp., on the west side of the river. This was originally covered with very large trees, six feet or more in diameter, the stumps of which are not yet entirely decayed. The second growth which has replaced this forest seems, fortunately for the purpose in hand, to be a fairly natural association, altho the herbage in all but the wettest parts is so modified by pasturing that it can give no idea of the original association.

The larger part of the area may be described as a maple swamp, in which *ACER RUBRUM* covers the ground in places to the exclusion of all other species, both herbaceous and woody. Beneath the maples the ground is bare and muddy or covered with shallow puddles. In places where the maples are not so thick, a more varied flora appears, the principal components of which are:

<i>Alnus rugosa</i>	<i>Benzoin benzoin</i>
<i>Ulmus americana</i>	<i>Gleditsia tricanthos</i>
<i>Cephalanthus occidentalis</i>	<i>Salix nigra</i>

Where the land is a little dryer, numerous other trees appear; among these the following are abundant enough to deserve mention:

<i>Quercus palustris</i>	<i>Quercus imbricaria</i>
<i>Malus glaucescens</i>	<i>Carpinus caroliniana</i>
<i>Juglans nigra</i>	<i>Juglans cinerea</i>
<i>Fraxinus pennsylvanica</i>	<i>Fraxinus americana</i>
<i>Quercus bicolor</i>	<i>Prunus virginiana (serotina)</i>

In other places, permanently covered by the water coming from several springs at the base of the hillside, the ground is bare of trees and a very interesting association of shade-enduring swamp herbs has



Fig. 9. Lizard's Tail (*Saururus*) in the Bottomland Swamp.

developed. In the spring this association is dominated by *CALTHA PALUSTRIS* and *SPATHEMA FOETIDA* with, as secondary species:

Senecio aureus

Cardamine rhomboidea

Ranunculus septentrionalis

Ranunculus sceleratus

During the summer, *SAURURUS CERNUUS* (fig. 9) dominates the association, while in the autumn its place is taken by *POLYGONUM ARI-FOLIUM*, with which are a large number of species in greater or less abundance, including the following:

Chrysosplenium americanum

Alisma subcordatum

Carex sp.

Penthorum sedoides

Isuardia palustris

Bidens connata

Bidens aristata

Bidens cernua

Lobelia cardinalis

Lobelia syphilitica

Lilium canadense

Solidago patula

Phlox maculata

Blephariglossis lacera

On one side this swamp is contiguous with a wooded hillside bearing the usual forest of the coves. At the meeting place the two associations are sharply demarked by the character of the soil. There is no sign of the encroachment of one association on the other and no tension zone between them.

THE BIRCH BOTTOM LAND

One often reads accounts of the settlement of the country by the pioneers of bottom-lands covered with birch instead of willow, but so



Fig. 10. The Birch Bottomland on Queer Creek.
Betula lutea in almost pure stand.

far as Ohio is concerned, these have almost completely vanished. Birch bottoms, however, must originally have abounded along the streams in

this region. But now all of the flood-plains not under cultivation are occupied by the usual mixed association of deciduous trees, dominated by the willows (principally *Salix nigra*) and the sycamore, together with coarse weeds, such as *Ambrosia trifida*, and various composites. Although birches are common along the streams from Laurel Run southward, it is only in the canyon of Queer Creek that anything like an unspoiled birch bottom can be found, and even here the undisturbed association remains in only a very limited area—less than an acre all told—and there is a considerable admixture of species which were not present in the association in primeval times.

The land is flat, with numerous shallow pools furnishing breeding places for salamanders, etc. The soil is almost pure sand, with little humus, most of the organic matter being in the form of undecayed particles of wood.

The two birches, *BETULA LUTEA* and *B. lenta*, are both abundant, the former occupying nearly one-half of the area (fig. 10), while the river birch, *B. nigra*, occurs on the edge overhanging the stream. Together with these are scattered individuals of hemlock (*Tsuga*) and beech, (*Fagus*). Along the water's edge, where the light is stronger, are some other trees which are probably intruders since the days of floods. These are: Ash (*Fraxinus americana*), sycamore (*Platanus*), basswood (*Tilia*), butternut (*Juglans cinerea*), blue beech (*Carpinus*), and red maple (*Acer rubrum*). The underbrush is made up of yew (*Taxus*), with some witch hazel (*Hammamelis*) and spice bush (*Benzoin*).

The real character of the herbage is very difficult to determine, for there is an admixture of all sorts of plants from almost all possible associations, especially weeds whose seeds are continually brought in by the stream. One cannot be sure which to eliminate as intruders, since there are no other areas to use for comparison. The following list, however, seems to include most of the characteristic plants:

Circaea lutetiana

Circaea alpina

Dryopteris spinulosum

Dryopteris marginale

Lycopodium lucidulum

Cathrinca sp.

To these must be added the Virginia creeper (*Parthenocissus*) which is common but so small that it must be classed as an herb, seldom rising off the ground. This plant might be described as waiting round for an opportunity to assert itself. The weak light that reaches it is

just enough to support it, but does not permit any but the slowest growth. But whenever a break in the forest lets in the light, it is ready to spring up luxuriantly and cover the open places.

It will be observed that this herbage is very similar to that of the hemlock forest (see p. 269) which covers the hillside above the flat, and it is clear that the two associations are closely akin. The one passes into the other abruptly as the level land gives way to the hillside, the place of *Betula lutea* being taken by the hemlock, while the yew, the ferns and the lycopod become more abundant.

The one factor which more than any other appears to be responsible for the development of this association is the absence of light. This is pre-eminently an association of sciophytes. On both sides it is hemmed in by lofty cliffs, which greatly reduce the light reaching the bottom. The shade is so dense that of the many weeds which one finds starting up in the spring all but a few stunted individuals have died off for lack of light by mid-summer. A shade-enduring community is, however, of necessity slow growing, and when once the shade is removed, this association has little chance of reproducing itself against the competition of the aggressive, sun-loving plants which form the common bottom-land association throughout the Central States.

THE RIVER BANK ASSOCIATION

While the vegetation on the banks of the larger streams is a heterogeneous mixture of all sorts of elements, especially annual weeds, the banks of Queer Creek are covered in places with an association of geophilous perennial herbs which is close to the natural condition. This may be observed, perhaps to greatest advantage, on the banks of the basin below The Falls at the head of "The Gulf."

It develops on banks which are too frequently overflowed to permit the growth of trees or bushes. Consequently it is well illuminated. The soil is loose, almost pure sand, which is held in place by the underground parts of the vegetation.

The dominant plant is *Panicum latifolium*, with *Carex prasina* and *Senecio aureus* in considerable abundance, while *Phlox maculata*, *Rudbeckia laciniata* and *Lobelia syphilitica* are usually present and, by reason of their flowers, conspicuous. Where the association is somewhat shaded, *Lobelia cardinalis* appears in abundance, becoming the fascies in August.

As normally developed this association is always confined to a narrow strip a meter or two wide bordering on the water. But it is one of the associations which have become greatly extended since the clearing of the country. In the cleared lands, however, it does not develop in its purity, but becomes a meadow covered with *Panicum latifolium*, together with various sedges, rushes, and other common meadow and pasture plants.



Fig. 11. The Hemlock Forest on Queer Creek.

THE FORESTS

A. THE LOWLAND FOREST

The Hemlock Forest. The deepest forest in the region is that formed by the hemlock, which is most luxuriant on the sides and bottoms of the deeper ravines south of Clear Creek (fig. 11). The individual hemlock trees are common enough all through the area, the pure hemlock forest is not found north of that stream.

In its extreme form the hemlock forest is an unmixed association of hemlocks, no other vascular plant but *TSUGA CANADENSIS* being present. More often, however, *Betula lenta* is associated with *Tsuga* and the ground is not bare but occupied by the yew (*Taxus*), and herbage consisting of:

Dryopteris spinulosum
Lycopodium lucidulum

Mitchella repens
Tiarella cordifolia

There are also usually numerous seedlings of soft maple (*Acer rubrum*). In almost all the forests, indeed, this species furnishes a majority of the tree seedlings, but nowhere except in the bottom-land maple swamp do the full grown trees become at all abundant. While maple seedlings seem to be better able to endure deep shading than those of other forest trees, they do not seem to be able to compete with them when, by a break in the forest canopy, a place is made for a new tree. In the abundant illumination supplied by the displacement of one of the original forest trees, other species are apparently able to grow enough more rapidly to overcome the lead of the maple seedlings already present and to succeed to the vacant place.

Where the association begins to give way to the mixed deciduous forest which usually adjoins it, a few beeches and maples usually come in, and both underbrush and herbage become more abundant and varied, the former consisting of:

Parthenocissis quinquefolia
Viburnum acerifolium

Hammamelis virginiana
Cornus alternifolia

While in the herbage appear:

Viola blanda
Dryopteris spinulosum
Peranum pubescens

Medeola virginica
Unifolium canadense

And in less typical portions are found:

Dryopteris marginalis
Hepatica acuta
Actea alba
Arisaema triphyllum

Circaea alpina
Carex plantaginea
Ranunculus recurvatus
Asarum sp.

The frequent association of the sweet birch (*B. lenta*) with the hemlock seems to be due to the similarities in their root systems. The seedlings do not develop a tap root, but form a much-branched system of fibrous roots, which spread out freely near the surface, never attaining any great depth. They are therefore especially suited to rocky situations in which penetration is difficult or impossible, and they are



Fig. 12. A Cascade in the Hemlock Forest.

limited to substrata furnishing a constant supply of water near the surface. Very few soils, however, can maintain such a condition except when bathed in a heavily moisture-laden atmosphere. In such humid habitats both species do well regardless of the substrata, growing almost everywhere and showing a strong tendency to become epiphytes. But

in this region almost all of the seedlings that start as epiphytes as, for example, in the mossy covering of a fallen log, soon exhaust their moisture supply and succumb to drouth; but occasionally one gets a root down into the ground and continues to grow. On Queer Creek,



Fig. 13. The Bottom of Kunkle's Hollow, Formerly Occupied by the Hemlock Forest.

one such birch sapling was noticed, in this case *Betula lutea*, which had started on a hemlock stump nearly a meter from the ground. It had reached a diameter of nearly a decimeter, was supported on "stilts"

formed by its strong roots, and gave every evidence that it would continue to grow and become a large tree.

On account of the character of the root system of the plant, the hemlock forest has small opportunity to reproduce itself when once it is cut off. The removal of the trees changes the ravines from the coolest to the hottest parts of the country and the shallow-rooted seedlings have small chance of survival. It is fortunate indeed, therefore, from a practical point of view, that the commercial value of hemlock timber is less than that of the trees with which reforestation may occur.

The cause of the non-occurrence of the hemlock forest in the northern section of our area is apparently due to a slight difference in physiography. On account of the greater thickness of the sandstone to the southward, the valleys are younger in a physiographic sense; the canyon walls are higher and more nearly continuous along the larger streams, and in the smaller ravines the waterfalls are higher and more numerous than further north. In these deeper ravines conditions are more extremely mesophytic, if the term be permitted, than elsewhere. That is to say, conditions here more nearly resemble those in the most typical of all mesophytic formations, the tropical rain-forest, than anywhere else in our area. The atmosphere is kept continually near the point of saturation, while the shade in the deepest portions of the forest is so intense as to absolutely prohibit the growth of plants other than the forest trees themselves.

When the valleys have become somewhat older and developed sufficiently to have a mantle of soil on the bottom and up the sides, the hemlock sooner or later gives way to the *Liriodendron* forest. Under natural conditions this may not happen for thousands of years as, for instance, in the Queer Creek canyon, where a typical hemlock forest occupies a deep bottom land soil and probably would continue to do so for a long time to come. But even here the bank of the stream is occupied by various deciduous trees which would gradually but certainly beat back the ancient hemlock forest. In the typical *Liriodendron* forest, as seen further north, the hemlocks and birches are limited to the rocks forming the upper rims of the ravines, while the whole of the soil-covered valley is dominated by the deciduous forest about to be discussed.

The Liriodendron Forest. The *Liriodendron* forest flourishes in conditions but little different from the hemlock forest which it is gradually replacing. Its most typical development occurs in the characteristic

“Coves” which abound throughout the area. A cove (frontispiece), in the lumberman’s vernacular, is a short, steep ravine, surrounded by high hills or margined with cliffs, within which the timber, though brittle, is unusually tall, straight, and free from knots and wind checks. The reason for this character of the timber is, of course, the struggle for sunlight in which the trees on the bottom are placed at a disadvantage as compared with their neighbors higher up on the slope. The conditions for vegetation in these coves are highly favorable in respect to both climatic and edaphic factors. The soil is for the most part a loose, sandy loam, with considerable humus on the surface, but more sandy below, in places becoming nothing but sand, which is dug by the farmers and serves very well for domestic uses.

In these coves there develops a luxuriant forest, richer in species than any other association in our area. Like the hemlock forest, the Liriodendron forest has suffered severely from the lumberman until it is now difficult to find a good specimen for study. One of the best is the “Crystal Springs” ravine at Sugar Grove, which has been used as a summer resort for twenty years, during which time the timber has not been disturbed, although the underbrush and herbage have been more or less modified by the activities of picnickers and botanists. Another good cove is located about a half a mile north of Sugar Grove, near the pumping station in section 4, Berne Twp. This one was lumbered a number of years ago, but has since lain undisturbed, and in its herbage probably represents more normal conditions than the other. Unfortunately it was swept by a fire during the winter of 1909-10, which damaged it so much that it is no longer interesting to an ecologist. The picture of the cove forest here drawn is largely a composite of the conditions in these two ravines.

The forest of these “coves” is so diversified that often no one tree can be designated as the fascies, but all in all there is little question but that the tulip tree (*LIRIODENDRON TULIPIFERA*) is most characteristic. Following it, roughly, in the order of abundance, are:

<i>Castanea dentata</i> (especially on the higher slopes)	
<i>Tsuga canadensis</i> (also most abundant on the higher slopes)	
<i>Juglans cinerea</i>	<i>Quercus alba</i>
<i>Fagus grandifolia</i>	<i>Quercus velutina</i>
<i>Acer rubrum</i>	<i>Betula lenta</i> (on the steeper slopes)
<i>Nyssa sylvatica</i>	<i>Morus rubra</i>
<i>Hicoria orata</i>	

The underbrush in places, especially on densely shaded slopes with a northern exposure, consists of thickets of *Rhododendron maximum*

(fig. 14), almost without intermixture of other species, either frutescent or herbaceous. In general, however, a variety of smaller trees

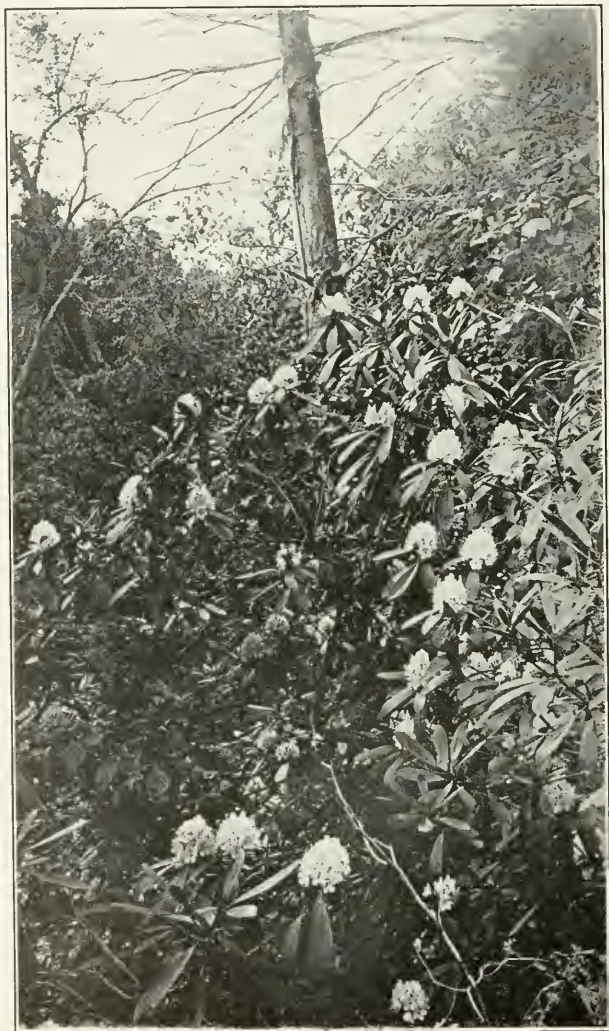


Fig. 14. The Rhododendron at Sugar Grove.

—Photo by J. E. Hyde.

and shrubs grow beneath the forest canopy. These are:

Hammamelis virginiana

Cornus alternifolia

Hydrangea arborescens

Cynoxylon (Cornus) florida

Azalea lutea

Viburnum acerifolium

Together with these are young individuals of the forest trees and stragglers from other associations which, though frequently abundant here, especially in places where the forest is younger, are gradually suppressed by overshadowing. The most abundant of these are *Sassafras*, *Orydendron*, *Kalmia*, and *Quercus prinus*.

As under-shrubs and semi-lianes are:

Smilax rotundifolia

Smilax echinrata

Clematis virginiana

Passiflora lutea

Parthenocirsus quinquefolia

Rhus toxicodendron

The last two in this forest, as in the birch bottom land, are strictly ground trailers, and though always common, are never luxuriant until a windfall or other accident lets in the light, when they shoot up with great rapidity into their well-known full liane form.

The herbage is composed of a large number of species belonging to several guilds. In the most shaded woods, in situations where at the same time leaf-fall is not too abundant, herbs with evergreen or hibernating leaves are abundant and conspicuous, especially during the winter, when other herbs are absent. These include:

Carex plantaginifolia

Hepatica acutiloba

Polystichum achrosticoides

Dryopteris marginale

Dryopteris spinulosum

Botrychium obliquum

Pyrola elliptica

Lycopodium lucidulum

Tiarella cordifolia (in the southern section)

Asplenium platyneuron

When not too much shaded and especially in younger second growth there is a rich development of vernal herbs typically geophilous and with showy flowers, such as:

Trillium grandiflorum

Blechnum canadensis

Blechnum cucullata

Erythronium americanum

Podophyllum peltatum

Arisaema triphyllum

Juncoides carolinac

Viola pubescens

Viola blanda

Viola rostrata

Viola palmata

Synedemon thalictroides

Viola canadensis

Botrychium virginianum

Galcorchis spectabilis

Fagnera racemosa

Aralia nudicaulis

Geranium maculatum

Thalictrum dioicum

Dentaria laciniata

Dentaria heterophylla (in southern section only)

Ranunculus recurvatus

Later in the summer the places of these are taken by another set of plants, including:

Cimucifuga racemosa (fig. 15)

Phytolacca leptostachya

Adiantum punctatum

Sanicula canadensis

Circaea lutetiana

Aster divaricatus

Aristolochia serpentaria

Medeola virginica



Fig. 15. Black Cohosh (*Cimucifuga*) in the Liriodendron Forest.

Chlorophyll-less phanogams are represented in abundance by the parasitic Squaw-root, *Conophyllis Americana*, and Beech Drops, *Lepetanthium Virginiana*, and the saprophytic *Monotropa uniflora* and *Hypomyces Americana*.

These Liriodendron "coves" once covered a large proportion of the northern section of our area. Below Clear Creek they are, and probably always were, scarce. Their place is taken almost everywhere by the hemlock forest which, as has been stated, does not extend north of that point.

B. THE UPLAND FOREST

The succession of associations in the upland forest is best seen by ascending the point of one of the long, narrow ridges between the ravines and walking back from the edge of the cliff through the pine woods into the oak forest and around to the head of the ravine where the upland merges with the lowland.

The Cliff Top. At the tops of the cliffs there is a narrow strip of what may be termed a miniature lichen tundra (fig. 16), since it possesses all of the essential features of the northern tundra. The substratum is extremely acid to litmus paper. It is exposed to the extreme

action of the wind and to the greatest extremes of temperature, together with the most sudden changes which are possible within the limits set up by the climate of the region. The flora is of the sort that has generally passed as xerophytic, but in reality it may not be so much xerophytic as oxyphytic. It bears little resemblance to the truly xerophytic flora of desert regions.



Fig. 16. The Miniature Tundra at the Edge of the Pine Forest.

The vegetation of the cliff tops develops into zones similar to those found around ponds, but in this case the zones depend on the depth of the soil and the exposure. The front rock is nearly bare, but supports a few foliose lichens (*Parmelia* sp.), a few small mosses seldom found in fruit, with occasional stunted stragglers from the next zones.

The outermost zone of vegetation is the lichen formation. It extends from the bare rock back until the soil has reached a depth of about a decimeter, when it gives way to the *Vaccinium* zone. The characteristic plants are:

CLADONIA spp.

Polytricum spp.

Lechea minor

Panicum sphaerocarpon

Carex (two or three species, including *C. triceps*.)

Houstonia longifolia

There are also numerous waifs from other associations. On this account the composition of the zone varies greatly from place to place

and from year to year in the same place. It is indeed the rocky ground in which the seeds of many plants fall and spring up quickly but wither away for lack of a root when exposed to the scorching sun. None but the cryptogams in the above list can be considered as constant inhabitants. But they are never found without the admixture of some seed plants, whether of the species listed above or others.

Most of the waifs here present are stragglers from the nearby forest, but two or three are interesting in that they do not occur in the forest. *Ambrosia clatior* found but little place in the primaeval vegetation of the region, since it is dependent on strong illumination, which was denied all of the plants on the forest floor. It is interesting to find it as a frequent inhabitant of such places, whether as an original native or as an introduced weed. *Hypericum drummondii*, which

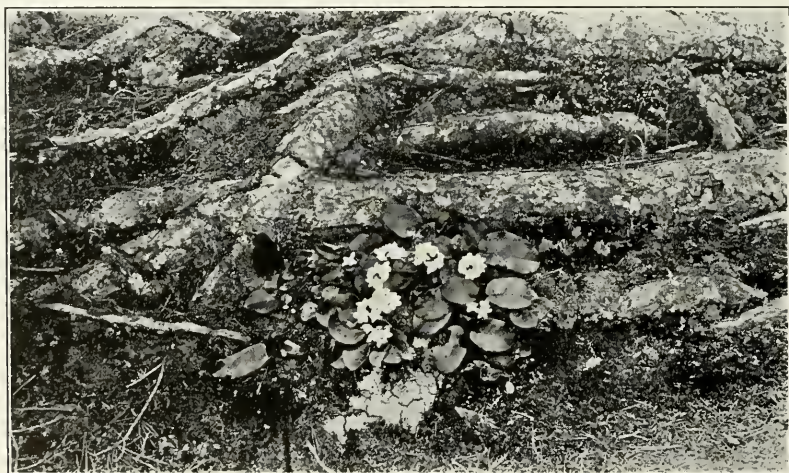


Fig. 17. A Small Plant of Trailing Arbutus Among the Roots of the Pines at the Edge of the Cliff.

reaches its extreme eastern limits in this area, was found in a single station in such a lichen formation. It was abundant in 1909, but very scantily represented in 1910.

Following the *Cladonia* association is a transitional shrub zone composed of:

Vaccinium vacillans

Polygodium stamineum

Gaylosaccia baccata

Epigaea repens (fig. 17)

Gaultheria procumbens

Mitchella repens

Smilax rotundifolia

Kalmia latifolia

Lespedeza repens

Lechea minor

Hypnaceae sp. (forming tufts)

Together with these are numerous individuals from the lichen zone on one side and the forest on the other.

This zone is in reality merely an extension of the underbrush of the

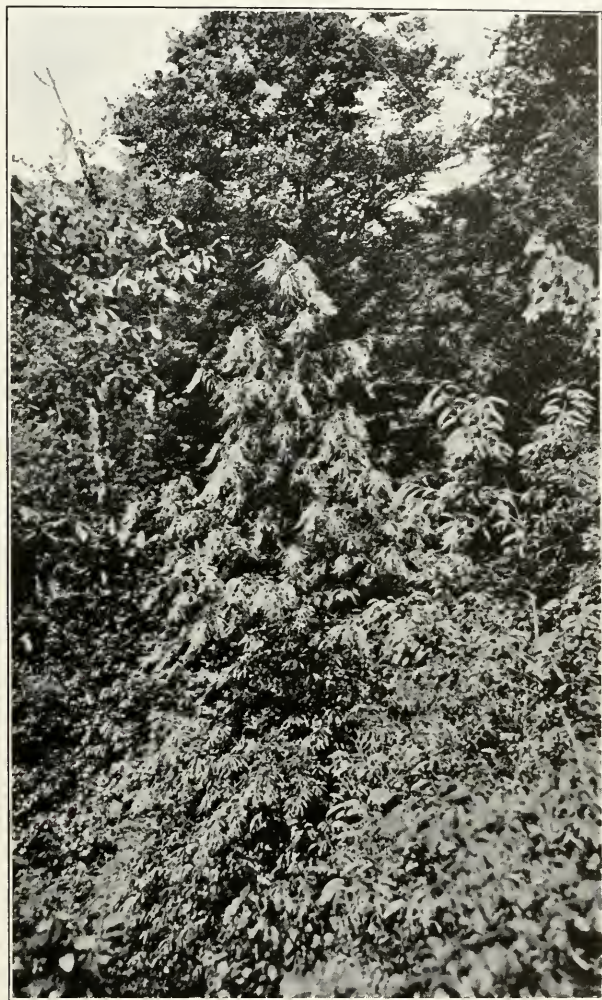


Fig. 18. Fruiting *Oxydendrum* in the Oak Forest. At the Left *Castana dentata*. At the Right *Acer rubrum*. In the Background *Quercus* sp.

pine forest behind it on to thinner soil than can support tree growth.

The Pine Forest. The zonal series is completed by the pine forest, which occupies the poorest soil capable of supporting arborescent plants.

It bears a general resemblance to the pine barrens common everywhere below the border of the glacial moraines. Its principal component species are:

PINUS RIGIDA	<i>Gaultheria procumbens</i>
<i>Pinus virginiana</i>	<i>Panicum dichotomum</i>
<i>Quercus velutina</i>	<i>Chimaphila maculata</i>
<i>Castanea dentata</i>	<i>Meibomia rotundifolia</i>
<i>Oxydendrum arboreum</i>	<i>Isotria verticillata</i>
<i>Vaccinium vacillans</i>	<i>Solidago nemorosa</i>
<i>Gaylussacia baccata</i>	<i>Houstonia longitolia</i>
<i>Polycolium staminium</i>	<i>Hieracium venosum</i>
<i>Kalmia latifolia</i>	<i>Panicum sphacelocarpon</i>
<i>Epigaea repens</i>	<i>Cunilla origanoides</i>
<i>Smilax rotundifolia</i>	<i>Lespedeza hirta</i>
<i>Smilax glauca</i>	<i>Lespedeza repens</i>
<i>Amelanchier canadensis</i>	<i>Lespedeza procumbens</i>
<i>Rosa virginiana</i>	

Together with these are numerous seedlings from other associations. Saplings of *Hicoria ovata* are nearly always present and here, as everywhere else, *Acer rubrum* comes up abundantly but attains no great size.

The Oak Forest. The pine forest occurs throughout the region on the more exposed ridges. Where the ridges become wider and the conditions are less severe, the pines gradually give way to the hard woods and a mixed oak forest is developed in which QUERCUS PRINUS is sometimes the dominant tree and occasionally occupies the ground almost to the exclusion of other arborescent species. With it are more usually present, however:

<i>Quercus alba</i>	<i>Hicoria minima</i>
<i>Quercus velutina</i>	<i>Hicoria ovata</i>
<i>Oxydendrum arboreum</i> (fig. 18)	<i>Nyssa sylvatica</i>
<i>Castanea dentata</i>	<i>Acer rubrum</i>

In the underbrush the heaths give way to the grapevine (VITIS BICOLOR), which is quite as typical a representative of the association as the oaks. With it are:

<i>Cynoxylon</i> (Cornus) florida (an under tree.)	<i>Smilax glauca</i>
<i>Smilax rotundifolia</i>	<i>Rosa virginiana</i>
	<i>Viburnum acerifolium</i>

The most characteristic plants of the herbage are:

<i>Meibomia nudiflora</i>	<i>Linum virginianum</i>
<i>Meibomia rotundifolia</i>	<i>Monotropa uniflora</i>
<i>Dasystoma laevigata</i>	<i>Hypopitys americana</i>
<i>Tithythymalopsis</i> (<i>Euphorbia</i>) <i>corollata</i>	

The upland oak forest originally covered a large part of the country, but it is very much restricted at present. Its boundaries coincide with the limits of arable soil. It has therefore been largely cleared away and is now to be found only in remnants around the borders of the fields. Its composition has, moreover, been greatly modified by the operations of the woodcutter, who has cut out the more valuable timber, leaving behind the inferior sorts to replenish the forest. As a result of this kind of lumbering the fascies through most of the oak forest has become the worthless black oak (*Quercus velutina*).

The two types of upland forest which have been described are the extremes between which are all intermediates. Most of the upland forest seen in the area, indeed, belongs to neither the one nor the other, but varies in composition, now approaching one now the other. For this reason and because it meets and intergrades with almost all of the other associations of the area, the oak forest is the most difficult of them all to characterize satisfactorily. The most noteworthy of these transitions, perhaps, is to the *Liriodendron* forest of the lowlands, with which it gradually merges at the heads of the ravines.

The Talus Association. The plant society covering the talus slopes at the bases of cliffs with south exposure is closely similar to the oak forest of the uplands. It should be explained, however, that the talus slope is very different from an ordinary talus slope. It is not made up of fragments of fallen rock, but of sand, which rattles down from the cliffs together with considerable amounts of vegetable debris which, on account of the porous character of the soil, are to a large extent oxidized directly without humification. The vegetation of these slopes differs from the oak forest principally in an admixture of plants from the rocks. *Quercus prinus* is more abundant and is accompanied by *Castanea dentata*, *Betula lenta*, *Mitchella repens*, and *Gaultheria procumbens*.

THE ROCK DWELLING PLANTS

Beside the forests, the most considerable body of vegetation is that which occupies the rocks. For the most part, however, the plants of the rocks can be better considered as individuals than as organized into definite associations. This is not only because the plants are so far apart that they could in any case be understood to form only a very open association, but also because many of the crevice plants are so erratic in their occurrence that there is no very definite composition

to the flora of the rocks. In one place the rock may be occupied by a given set of plants, while in the next hollow, under entirely similar conditions, different plants appear. This is well illustrated by the



FIG. 19. The Cliff at the Head of "The Gulf."
The figure at the top gives the scale. For list of vegetation see page 283.

distribution of *Asplenium montanum* within the region. It was first found for a few rods along a cliff at Sugar Grove; it has been found at the mouth of Clear Creek, again on Little Rocky branch and at

Cedar Falls. In each of these stations there are a few dozen clumps, but nowhere else has it been found, though search has been made in hundreds of likely places. The case of *Asplenium montanum* is extreme, but the crevice plants in general are sufficiently similar to it in their occurrence to make it inadvisable, except in the few instances given below, to try to group them into definite associations.

Moreover, a large proportion of the plants of the rocks really belong in neighboring associations and are merely chance seedlings of plants able to endure the conditions of the cliff. This is well illustrated by the flora of a cliff at Old Man's Falls at the head of "The Gulf," which is exposed to the burning sun all day long and presents very severe conditions. In this particular cliff the greater part of the vegetation is made up of woody plants which alone are considered here on account of the difficulty of listing the smaller herbs because of the height and inaccessibility of the cliff (fig. 19). They are:

Betula lenta

Pinus virginiana

Gaylosaccia baccata

Kalmia latifolia

Tsuga canadensis

Amalanchier canadensis

As already pointed out (page 270), *Betula lenta* has a root system requiring a supply of easily available water, such as is furnished in the crevices. With this requirement met it grows almost anywhere, from such exposed cliffs to densely shaded bottom lands. *Pinus virginiana* and *Gaylosaccia baccata* belong in the forest on top of the cliff, but are able to grow almost anywhere they can get a foothold. *Kalmia latifolia* is pre-eminently a sun-loving plant with large powers of endurance of all sorts of conditions. It is accordingly frequently found on exposed cliffs and in the primeval forest may have been confined to such places for lack of space elsewhere, but it reaches its best development in habitats where soil conditions as well as light exposure are more favorable, as, for instance, in pastures. The hemlock obviously belongs in the forest below, tho its root system resembles that of the birch and its distribution is controlled by the same factors. This leaves as a cliff plant only the *Amalanchier* (fig. 20), which seems to show a preference for steep places regardless of other conditions.

Even of those plants which are habitually rock dwellers some give clear evidence that they are so because crowded out of other habitats rather than from any preference for the rocks. *Polypodium vulgare*, for example, is for the most part as fastidious in its choice of rocky habitats as any plant in our region, but under special circumstances it

may leave the rocks and grow on the ground, or on the bases of the trees, as in the hemlock forest in Little Rocky branch, where such habits are permitted by the very great humidity, together with the absence of fall-



Fig. 20. Shad Bush (*Amelanchier*) on the Cliff Overlooking the Canyon of Queer Creek.

ing leaves and of competition of other plants. Likewise, when removed to a garden and competing plants artificially eliminated, it thrives well on the ground. This, moreover, seems to be an entirely normal habitat

in some regions. In Maine, Merrill¹ reports it as carpeting "the top of most of the ledges, or hanging gracefully over their brinks, or nestling beneath some evergreen tree, whose branches spread out their protect-



Fig. 21. *Sullivantia* Growing on the Face of the Cliff.

ing arms." At Sugar Grove the plant is quite limited, except in a few stations, to the edges of the rocks, neither carpeting their tops

1. Merrill, H. W. *Polypodium vulgare* in Maine. *Am. Fern Jour.* 1: 7-9, 1910.

nor running far onto their perpendicular faces. In other regions this same species is found in habitats that seem to an American botanist almost unbelievable. Warming² mentions it as occurring on gray sand dunes in Europe. Such habitats are entirely inexplicable on the hypothesis of a preference of *Polypodium* for any one of them, but are entirely consistent with the view that this species has been crowded out of the more favorable habitats and must grow where it can.

Doubtless there are crevice plants which have decided preferences for their habitats, and indeed some such occur in the present region, but the writer has been surprised to find that such other rock-dwelling ferns as *Camptosorus rhizophyllus*, *Asplenium trichomanes*, and *Asplenium montanum* grow thriftily in an ordinary garden bed. One may observe the same thing over and over again if he will read in the catalog of such a florist as Edward W. Gillett, who makes a specialty of cultivating the native plants, the directions given for managing various plants. One finds there that all of the cliff ferns succeed well if grown in a bed with good drainage, including, besides those mentioned above: *Pellaea atropurpurea*, *Cheilanthes gracilis*, *Polypodium vulgare* ("which will adapt itself to almost any kind of soil not too wet") and *Woodsia illeceensis*. Similar directions are also given for such chasmophytes as *Campanula rotundifolia*.

Sullivantia Cliffs. Wherever, under a waterfall or elsewhere, water trickles slowly down over an overhanging cliff sufficiently well illuminated, *Sullivantia* is apt to occur. It seems not to thrive except where its roots are kept constantly wet. In such situations it sometimes almost covers the face of the rock with its beautiful glossy foliage. *Sullivantia* is one of the plants which must certainly be classed as preferring the rock to all other habitats. It is never found far away from the cliffs, and though by far the larger proportion of its seeds must drop down on to the ground below the cliff, it only is rarely that one finds it growing there (fig. 21).

Isolated Boulders. The structure of the sandstone is such that along every ravine the cliffs are lined with large boulders which have cracked off and gradually slumped away down the slope. For the most part these rocks are occupied by societies occurring in other situations and already described, such as the shade-loving herbage of the forest floor or the huckleberry brush of the cliff top, according to the conditions prevailing on the particular rock. But there is at least one society which reaches its best development only on such boulders.

2. Ecology, p. 267.

The Unifolium Society. This is the Unifolium society, composed almost purely of *Unifolium canadense*, or mixed with the partridge berry (*Mitchella repens*) (fig. 22). This association occurs on shaded, flat-topped boulders, which in the course of time become covered with a few inches of almost pure sand derived from the decay of the rock beneath. Isolated as they are, plants in such habitats have no access to a supply of permanent ground water, but are dependent on the

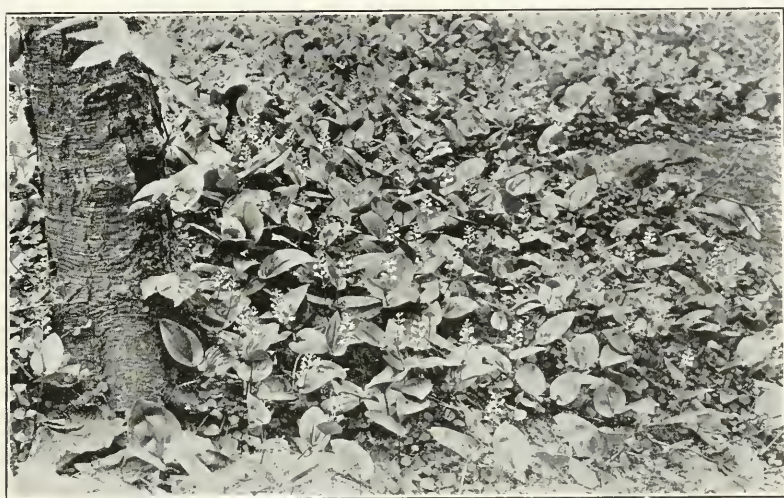


Fig. 22. "Wild Lily of the Valley" (*Unifolium*) on a Detached Boulder.
Betula lenta at Left.

amounts which can be conserved from rainfall in the scanty substratum. Such water is, of course, very meagre, the more so since the habitat is not adapted physically to retain water, and at the same time drains freely on all sides. When such rocks are exposed to the dessication of direct sun and wind, none of the seed plants can endure the conditions, but when protected by dense shade of the forest canopy above them, *Unifolium* develops thriftily. This plant is not, however, limited to isolated boulders, but occurs all through the area in numerous situations, varying from this periodically xerophytic habitat to the extremely mesophytic hemlock forest. It may therefore be inferred that the purity of the association is due not to any preference of *Unifolium* for the habitat, but to the inability of other plants successfully to invade it.

The Caves. Altho not, strictly speaking, always rocky habitats, the flora of the caves is clearly most nearly allied to that of the rocks. Altho they have some elements in common, the moisture content of these habitats separates them sharply into two classes.

Dry Caves. Old Man's Cave (fig. 23) is the dryest of the large caves. Its roof overhangs sufficiently to protect it from all rainfall,



Fig. 23. Old Man's Cave. *Aralia spinesa* in Foreground.
The ladder gives the scale.

and it has a southeast exposure, so that it receives sunlight till nearly noon. The sand which covers the floor is perfectly air-dry, very fine, and dusty enough to be unpleasant. It is totally barren except where water drips down from above or oozes out from the crevices of the rock, and is really a small patch of desert in the midst of luxuriant mesophytic habitats. Similar conditions are presented by many other caves of all sizes, down to mere ledges. In many of them, as in Old Man's Cave, the floor is considerably above the general level of the bottoms of the ravines in which they occur. In others the floor of the cave is continuous with the talus slope at the base of the cliff, in which case, if the conditions are not too severe, the flora is nearly allied to that of the talus slopes in general. (See p. 281.)

Verbascum Thapsus is perhaps the most characteristic plant of the dry caves, being nearly always found there. By reason of its very long, slender roots, which extend far and wide through the loose sand, and the protective hairy investment of the leaves, it is able to endure more severe conditions than any other plant whose seed reaches these places.

Muhlenbergia diffusa is another practically constant inhabitant of the dry caves, forming circles around the points where water drips from the roof, from which it reaches out radially as far as the water supply will permit, its development varying therefore from season to season.

The high bush blackberry (*Rubus allegheniensis*) likewise always occurs in such caves, thereby exhibiting an amount of endurance of xerophytic conditions which was surprising to the writer in view of its general habitat. But it is plainly evident that the conditions are too severe for its best development, as its canes are frequently killed back and never develop as robustly as in pasture lands. It flowers and fruits freely, however.

In Old Man's Cave a conspicuous place is taken by the angelica tree, *Aralia spinosa*, altho this cannot be said to be a general inhabitant of the caves, since it is rare north of Queer Creek.

Wet Caves. When the caves are moist and at the same time well illuminated, their flora differs but little from that of the forest floor. When, however, a cave is dark, all other conditions being favorable, the vegetation becomes arranged in something like a zonal series, according to the minimum light requirements of the constituent species, each of

which follows back into the cave as far as its particular light requirement will permit. A considerable number of species are frequently found in such habitats, but most of them must be classed as accidental. Among the few which seem to have a somewhat definite place in such



Fig. 24. A Wet Cave Occupied by Ferns (*Dryopteris marginale* & *D. spinulosa*) as far back as the Illumination Permits. Beyond them a Zone of Lichens. In the Foreground a Dead Cane of *Sambucus racemosa*.

habitats only three need be mentioned: *Sambucus racemosa*, the red elderberry, is oftentimes to be found only in such habitats, being apparently crowded out of other habitats. *Dryopteris marginalis* and *D. spinulosa* are, however, the most conspicuous and constant inhabitants of the wet caves. They follow far back into the weak light where, undisturbed by other vegetation, they form very beautiful and perfect rosettes, conspicuously oriented, of course, toward the source of light (fig. 24). Beyond the reach of any vascular plant is a zone of crustose lichens which covers the surface of the rock fragments.

THE GUILD OF SHADE-LOVING EVERGREEN HERBS

Most abundant on shaded rocks, tho often found in other habitats, especially in the upland forest, is a guild of plants which requires separate consideration. These are the prostrate or acaulescent herbs with evergreen or hibernating leaves. They share the advantages

possessed by all evergreen undergrowth in being able to carry on photosynthesis during the months when the trees are bare. But they labor under a disadvantage which very strikingly limits them to a peculiar class of habitats—namely, those which are free from a covering of fallen leaves.

The situation will be evident from the consideration of a typical case, that of the Rattlesnake plantain, *Peramium pubescens* (fig. 25). Its rosettes of leaves do not appear until late in the season, but persist through the winter and well into the following season. With its prostrate stem fixed on the ground, and its slow growth, it has no means of surmounting a covering of leaves, so that if deeply covered it is inevitably smothered. Not only is it deprived of light during the winter; it sends up no erect shoots to pierce the leafy blanket in the spring. The plant grows in varied habitats, such as rocks, hemlock



Fig. 25. Rattlesnake Plantain (*Peramium pubescens*) on a Boulder in the Forest.

forests, bare soil, and the banks of streams. Young plants may be found almost anywhere, as would be expected from seeds scattered by the wind, but well-developed clumps are only to be found in situations remaining nearly free from a winter covering of leaves. When, per-

chance, a few leaves fall around it, the petioles bend up nearly to a vertical position, raising the leaves to a certain extent above the obstruction.

As in every other guild of plants, the members of this one are not all typical, but intergrade with various other guilds, from lianes to rosette plants, and in so far as they depart from the characters of the guild, they escape its limitations. Some of them, like the partridge berry, *Mitchella repens*, have a sufficient power of growth to raise themselves above a leafy blanket which may be heaped upon them. Thus, though normally prostrate, this plant forms ascending shoots a decimeter or two high when it is buried under leaves. Nevertheless, its distribution is largely controlled by this one factor. It is perhaps most at home on sloping boulders and the edges of banks, but covers the ground in the hemlock forest where the falling leaves are so small as to pass down between its blades. In one case it was found even in the deciduous forest on a pile of stones, only a decimeter or so in height, but just sufficient to stand out from among the leaves. Others, like *Hepatica* or *Polystichum*, send up their new leaves so early in the season that even when covered up the handicap is soon thrown off. In such cases, covering beneath fallen leaves means simply the loss of photosynthetic activity during the winter, which might be supposed to be inconsiderable. Nevertheless these plants usually attain their best development in places too steep to permit the accumulation of leaves upon them. Still others, like the wintergreen, *Gaultheria procumbens*, are not strictly prostrate, but in their aerial parts approach more nearly to the upright condition. This plant, together with some others, is an Oxyphyte, and this character combines with the one under discussion to limit it to situations free from leaf fall.

Doubtless all of the ordinary biennial rosette plants, such as the shepherd's purse, would likewise be sensitive to a covering of leaves, but with them this is not an important factor because they are sun-loving plants of exposed situations, where leaves would never accumulate in any ease. It is only for plants growing beneath the forest canopy that this factor can become of importance.

The plants of the Sugar Grove area which belong to this guild are:

1. Typical shade-loving evergreens with leaves appearing late in the season:

Peramium pubescens

Pyrola elliptica

Camptocorus rhizophyllus (fig. 26)

Polypodium vulgare

Epigaea repens (fig. 17)

2. Shade-loving herbs with hibernating leaves replaced in spring by new ones:

Hepatica acutiloba

Hepatica hepatica

Carex plantaginca

Dryopteris spinulosum

Dryopteris marginalis

Unifolium canadense

Tiarella cordifolia



Fig. 26. The Walking Fern (*Camptosorus rhizophyllus*).

3. Evergreen herbs with leaves or shoots ascending sufficiently from the ground partially to surmount a blanket of fallen leaves:

Mitchella repens

Gaultheria procumbens

Lycopodium lucidulum

Lycopodium complanatum var.
flabelliforme

THE UPLAND THICKETS.

The Sumac Thicket. There are many steep slopes in the area where the rock comes so close to the surface as to prevent the growth of trees, but yet is not precipitous and retains a thin covering of soil. Here a thicket develops which is dominated by *RHUS COPALLINA* and *ANDROPOGON SCOPARIUS*, with the following secondary species:

Malus glaucescens

Specularia perfoliata

Rubus procumbens (Dewberry)

Meibomia canescens

Smilax glauca

Potentilla canadensis

Rubus alleghiensis (Highbush B. B.)

This association originally occupied a very small amount of territory in this area, but since the land has been cleared and cultivated a

very large and ever-increasing proportion of the area is growing up into thickets very similar to the natural Sumac Thicket which, like the Riverbank association, may be said therefore to have greatly extended its boundaries since the advent of man. These Old Field associations are not, however, altogether similar to the natural societies, but show a considerable admixture of species not found in them.

The Old Field Associations. It has already been remarked that the uplands require very careful handling to prevent washing and wasting of the scanty soil. Thousands of acres throughout the region have thus gotten away from their owners and become worthless for agricultural purposes. In these lands and other worn-out fields there has developed a somewhat definite association which covers a larger portion of area than any of the natural associations. In many respects it resembles markedly the Sumac Thicket just described, but its soil, though very poor, is not so closely underlain with hard rock, and so permits the growth of numerous species which do not find a place in the natural thicket.

The first plants that come into such fields, often appearing in numbers before abandonment, are *ANDROPOGON SCOPARIUS* and *A. VIRGINICUS*, which sometimes occupy the ground almost to the exclusion of other species.

After them, or in pastured land instead of them, appear various weedy plants, among which are:

<i>Ascyron hypericoides</i>	<i>Houstonia longifolia</i>
<i>Gnaphalium decurrens</i>	<i>Hedcoma pulegioides</i>
<i>Mcibomia canescens</i>	<i>Mcibomia obtusa</i>
<i>Potentilla canadensis</i>	

Next come in the mountain sumac, *RHUS COPALLINA*, together with the following plants completing the association:

<i>Rubus procumbens</i> (Dewberry)	<i>Solidago nemoralis</i>
<i>Lepedeza hirta</i>	<i>Rubus alleghiensis</i> (Highbush B.B.)
<i>Corylus americana</i>	<i>Hypericum prolificum</i>
<i>Malus glaucescens</i>	<i>Tithymalopsis corallata</i>
<i>Smilax glauca</i>	<i>Solidago juncea</i>
<i>Ibidium gracilis</i>	

After these plants have fully occupied the territory, reforestation begins by the appearance of some of the arboresecent species, among which the first comers are often the *Sassafras* and the Persimmon (*Diospyros*), together with the pines, *P. RIGIDA* and *P. VIRGINIANA*; which finally take possession to the exclusion of other trees.

The Sycamore (*Platanus*) often appears at this stage and grows vigorously even on land entirely denuded of its soil and exposed to extreme drouth. At the same time its absence from the undisturbed bottom land associations, such as the swamp and the birch bottom land, is not less noteworthy than its presence here. The explanation is to be found in the fact that the sycamore is not, as commonly supposed, a water-loving tree, but rather requires a large amount of light. In the primeval forest sufficient light was to be obtained only along the larger water courses, and for this reason, rather than because of a need of a large amount of water, the sycamore was found only along the streams.

In many places, especially where washing has been severe, the old field association develops only fragmentarily and the pines, which take some time to get started, are the first woody plants to occupy the land, so that reforestation begins without the intermediate steps more usually found. But in any case the pine forest comes to occupy most of the old fields, while on the ground, in more or less profusion, depending on the density of the shade, are most of the plants of the preceding thicket formation, together with *Chimaphila maculata* and the saprophytic *Coralarhiza odontorrhiza*.

Although the soil of such forests would appear to be very poor, it is interesting to note that occasional specimens of *Liriodendron* are often found among the pines and appear to thrive. None of the tulip trees observed in such situations had reached a very great age, and most were broad topped, not slender like the trees of the coves. But their thrifty appearance would suggest the feasibility of seeding down such land with *Liriodendron*, which is at once a more rapid grower and a more valuable timber tree than the pines which it would replace. While one would not care to recommend this practice widely on the basis of such fragmentary observations, it would appear to be clearly worth while to experiment in such situations with *Liriodendron* on a small scale with a view of determining its feasibility for general use.

The normal succession, however, would never be a forest of *Liriodendron*, but rather that already described in the upland forest. Although none of the second growth pine forests observed had attained any great age, it is altogether probable that they would come to resemble closely the virgin pine forest already described and that they would finally give way to the oak forest.

ECONOMIC ASPECTS

No scientific study is necessary to demonstrate that the land of this area is becoming poorer and poorer as its resources are dissipated under the present wasteful system of management. Everywhere one sees abandoned houses; in some parts of the area hardly half the houses are now occupied. Old "worn-out" fields are numerous and the number is increasing rapidly year by year.

The causes which have led to this condition are several: First, the greatest natural resource of the area was its timber. This has been cut off to such a large extent that it is difficult to find even small patches of undisturbed forest for botanical study. Lumbering is usually carried on in one of two ways, depending on whether the timber is to be made into railroad ties or sawed into lumber. Railroad ties, consisting especially of Chestnut and Rock Oak, are usually cut and worked by the owner of the land during the winter season. The large timber having long since been removed, those trees of sufficient size to make ties are felled and worked up in situ with but little disturbance of the young growth around them. Except from the danger of fires from the unused refuse and the fact that by this means the undesirable species are left to grow and multiply while the valuable woods which are cut out become scarcer and scarcer, this method of lumbering when conservatively practised has much to recommend it. When, on the other hand, a portable sawmill is brought into the country, its crew usually buys the standing timber from the owner of the land. The lumberers having no interest in the land, proceed to skin it, cutting every stick capable of being made in a piece 2 by 4 inches or larger, with no regard for the future. This method of lumbering is the most important cause of the increasing poverty of the country. While the land-owner usually secures a price sufficient to compensate him for the loss of the land, as well as the timber, the community is permanently impoverished by the loss of a forest which, if conservatively handled, would have been a permanent asset.

Second, with the removal of the timber soil acidity* becomes very prevalent and more and more land becomes utterly unfit for cultivation.

I apply the word acidity here, for want of a better term, to soils which when moist promptly redden blue litmus paper. In using the term I would not be understood as stating that the reddening of litmus paper is a criterion of acidity, or of taking any position in the controversies which are waging regarding this puzzling problem. I have merely noticed a very marked and definite correlation between the wild vegetation and the reaction of the soil to litmus paper.

Thus many exposed fields are discarded as worn out, when the worst trouble apparently is excessive acidity.

Third, the slope of most of the land is so great that it is in danger of washing whenever cultivated. Hundreds of acres throughout the area which might have continued as fairly good upland pastures have become hopelessly gullied "bad lands" (fig. 27) because the owner attempted to cultivate them.

This state of affairs is generally accepted as irremediable on the supposition that the land is so poor that early exhaustion is inevitable. Long observation of the deterioration of this land, however, has con-



Fig. 27. A Badly Washed Upland. Little but Dewberries (*Rubus procumbens*) Can Survive the Erosion.

vinced the writer that the case is by no means hopeless. While he would not pretend to recommend a remedy on the basis of present knowledge, there is abundant prospect that an experimental study of the situation would develop a system of management which would be profitable in the long run to both the land-owner and the community.

If the conditions described were confined to the Sugar Grove area alone there would be little justification for the expenditure of the time and money necessary to determine the best means of meeting the situation. But while such conditions may reach their climax in the present area, they are more or less general over all of the unglaciated portions

of southern and southeastern Ohio. On this account the determination of the most profitable method of managing these hill lands is a matter of very great importance to the welfare of the whole state and ought on that account by all means to be taken up without delay.

The progress of the deterioration of the land in this section is difficult to follow in the fields where the vegetation is made up of annuals and cultivation introduces many complications. But in the woods, where the plants are perennial, the gradual change in the vegetation as the land deteriorates and the factors which are at work are comparatively easy to observe.



Fig. 28. West Bank of Ravine. Note Leaves and Young Growth.

The cause may be summed up in the one word exposure. Wherever through thinning of the forest the wind is allowed to get in to the floor of the forest, the vegetation quickly changes. In the underbrush, plants characteristic of rich humus give place to others characteristic of barren hillsides, and the seedlings which are to replace the forest trees are of species of the same type. Thus the rich lowland forest is rapidly giving way to the poor upland forest. The most characteristic result of clearing the land is thus a descent of the upland vegetation into the lowlands.

The most striking examples of this descent of upland vegetation occur in north and south ravines, where the best timber has been culled out but the forest has not been cleared away. On the west slope of such ravines the lowland forest usually maintains its ground, but on

the opposite east bank there develops an association resembling closely the upland forest, especially in the character of its undergrowth. Typical examples are to be found in a branch of Brushy Fork, located in the southwest $\frac{1}{4}$ of section 9, Berne Twp., and in the hollow below Cantwell Cliffs, at the head of Buck Run.

On the west bank of such ravines the ground is covered with a deep layer of leaf mold in which there is a rich development of spring flowers, such as *Trillium grandiflorum* and *Galeorchis spectabilis*, unless, as in the Brushy Fork ravine (fig. 28), the ground is too heavily shaded.

On the opposite slope, however (fig. 29), the undergrowth comes to be made up largely of plants characteristic of the extreme upland forest, such as:

Kalmia latifolia
Vaccinium vacillans
Gaultheria procumbens
Epigaea repens
Gaylussacia baccata

Hieracium venosum
Viola hirsutula
Folytricum sp.
Cladonia sp.
 Tuft-forming *Hypnum*s



Fig. 29. East Bank of Ravine Shown in Fig. 28. Note Absence of Leaves and Saplings.

It is clear at a glance that the more commonly considered ecological factors must be closely similar on the opposite sides of such ravines. Since the axis is north and south the light received on the two sides must be equivalent and there can be but slight difference in the amount of rainfall. The soil being residual derived from the weathering of the

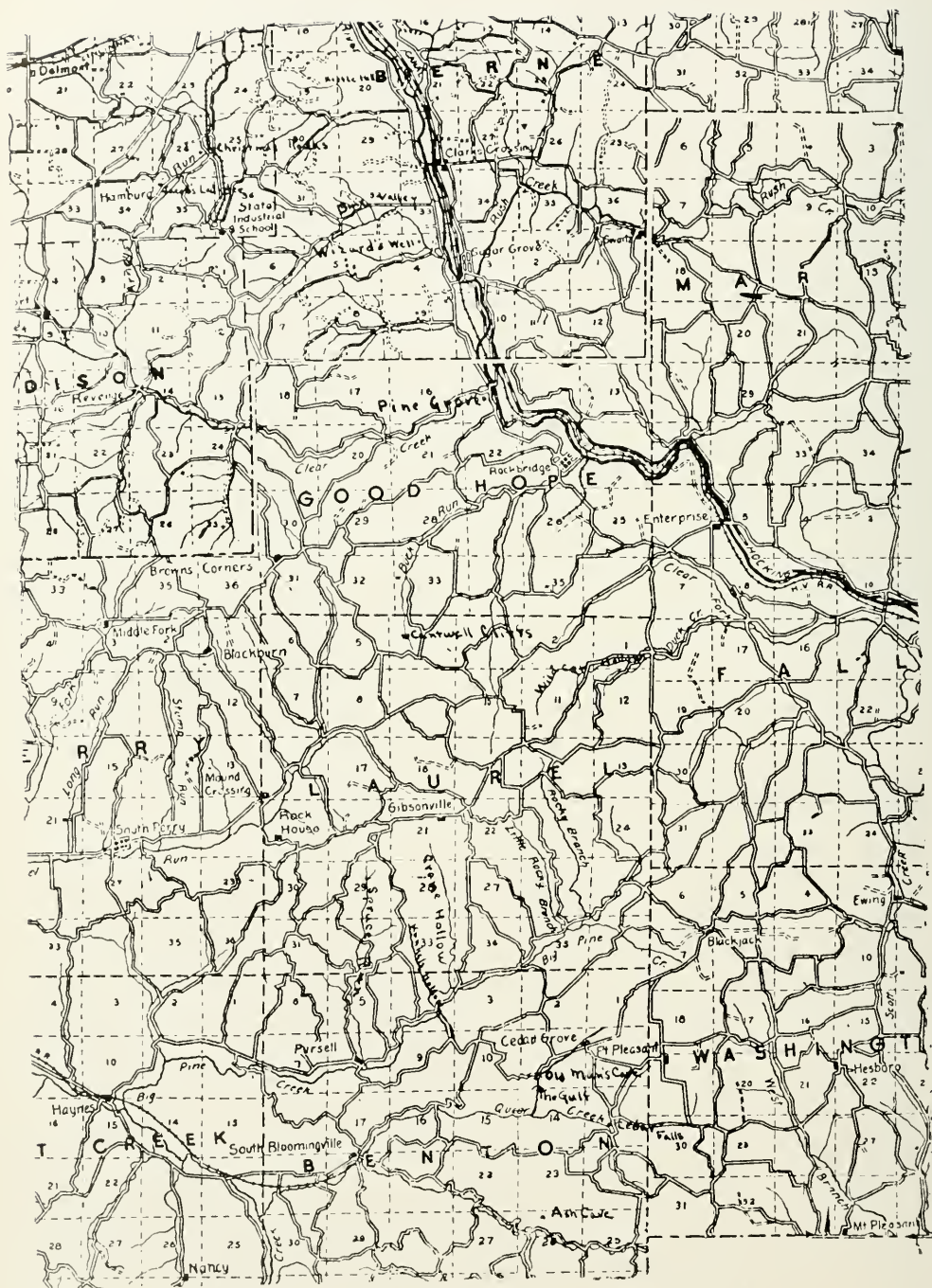
same rocks cannot have differed, in the beginning at least, in any important respect on the two sides. The only obvious difference between the two slopes is the condition of the surface of the ground. The west slope is covered with a deep carpet of fallen leaves and leaf mold while the opposite slope is swept bare of leaves by the wind so that there is little or no humus formed and the ground is somewhat more exposed to erosion from surface runoff. The soil of the west bank gives a neutral or faintly acid reaction to litmus paper. That of the east bank, on the other hand, gives a very strong and almost instantaneous red reaction. This is remarkable in view of the abundance of organic remains which must liberate various acids in course of humification in the neutral soil while the opposite acid bank is free from any such source of acidity. Repeated tests throughout the area have uniformly shown that wherever the characteristic upland forest develops, there the soil gives a strongly acid reaction to litmus paper. The soil of the lowland forest, on the other hand, always gives a faintly acid or neutral reaction to the same test.

Although such conditions have often been ignored in American ecological papers, they are clearly recognized in Europe. Warming in his "Ecology," for example, speaks of the importance of sour humus again and again. On page 62 he describes conditions practically identical with those found in the Sugar Grove region as follows: "Raw (sour) humus appears in forests, especially in places exposed to wind, while ordinary humus, with its earthworms and other animals, reigns in places sheltered from dessication; when ordinary humus in the beech forest has given way to raw humus because of timber falls and such like, then the beech, being no longer capable of regenerating, disappears, and is often replaced by calluna heath."

While the situation is more complicated in the case of cultivated fields, it seems not unlikely that exposure is an important factor in increasing their sterility just as with the forests. This probability together with the fact that exposure and danger from wash in large measure go hand in hand would seem to lay down very clearly the lines along which experimentation should proceed.

The only practicable method of reducing exposure is, of course, reforestation. Reforestation of all washed slopes and of all in danger of washing, would not only save the soil in many fields where it is certain to be washed off sooner or later, but would provide windbreaks sufficient to protect the larger part of the more level upland fields.

The best and most profitable method of accomplishing reforestation under the varied conditions presented are of course matters to be determined by experiment. But it cannot be doubted that tree planting would be profitable on much land that is now going utterly to waste. White pine (*Pinus strobus*) has been recommended as the best tree to plant in this sort of country, but in view of the imminent liability of the introduction of the pine rust (*Peridermium strobi*) it is doubtful whether this species should be used. The observations reported above (p. 295) indicate the advisability of giving the tulip-tree (*Liriodendron tulipifera*) a trial even on the steep slopes. The probability is that it would not succeed in some of the most difficult situations which might be first seeded to some quick-growing cover. But where it could be grown it would appear, on account of its rapid growth, valuable timber, and freedom from insect and fungus enemies, to be the most promising species with which to experiment.



Map Showing Roads and Localities in the Sugar Grove Area.
Scale 3 miles per inch.

FLORA

The Sugar Grove region has been collected over by all of the Botanists resident in Central Ohio from the time of Sullivant down. The specimens gathered by later collectors have to a large extent been deposited in the State Herbarium at Columbus until there has accumulated a fairly representative, though by no means complete, collection of the plants of the region. The list which follows is mainly a compilation of those species represented in the State Herbarium from either Fairfield or Hocking Counties. Some, however, are taken from Bigelow's list (see below) or were noted but not collected by the writer. An effort has been made to collect all those species whose occurrence or determination any one might wish to verify, but many of the commonest plants, such, for example, as *Rumex obtusifolius*, were simply noted as seen but were not pressed. For the protection of those who use the catalog, however, all species not represented in the State Herbarium are specifically noted.

The writer has not attempted to verify the determinations systematically, since they were all made by competent authority and most of them were verified by the late Prof. W. A. Kellerman. But whenever a species has aroused suspicion because apparently out of range or for any other reason, the specimen has been carefully scrutinized.

There may be grounds for criticizing the writer for including all plants known from the two counties in which the area lies rather than confining the list to plants known to occur in the region proper. Since, however, the region has no sharp boundaries and its limits have been somewhat arbitrarily fixed by the writer it will be seen that it would be altogether impossible to determine whether a given herbarium specimen with a more or less indefinite record of locality was collected within its limits or not. The increase in the apparent size of the flora from this cause, however, is not believed to be great, because, except for the special conditions in Buckeye Lake, the country is of sufficiently uniform character to make it probable that any plant reaching either of the counties in which the area lies, occurs at least as a straggler within the area, even though it might not be easy to find it there.

In the preparation of this flora I have derived very great assistance from the unpublished manuscript of the Fifth State Catalog of Ohio Plants by my colleague, Professor John H. Schaffner, to whom indebtedness is gratefully acknowledged. The arrangement, except in minor details, follows Schaffner's phyletic system which the writer

confidently believes will be found, when once the worker becomes familiar with it, as far superior to the classification of Engler now generally used as was that to DeCandolle's which it superseded. Those unfamiliar with the new arrangement will doubtless experience some inconvenience in using it at first, but that is a difficulty inherent in any improvement. At the end, I have added a Synopsis-summary by which the location of the families may readily be found.

The nomenclature, following the Ohio list is that of the second edition of Britton & Brown's Illustrated Flora. Recent synonyms have been added where they seemed necessary or desirable to make the list intelligible to all readers.

The Sugar Grove region is unique for this part of the country in that its flora was worked up by John M. Bigelow*, more than seventy years ago. Bigelow was an able botanist, companion and friend of Sullivan, for whose ability one finds an increasing respect as he scrutinizes his work. Basing my judgment almost entirely on his remarkable list, I have great confidence in his determinations and have unhesitatingly included most of them in the present list. He found a very large number of very rare plants just on the edges of their ranges or just beyond their present range as we know it, but there are few if any "wild" reports of species entirely out of range such as one would find in the inaccurate work of a less able man. He lists 871 species and varieties all of which with two exceptions he found growing in Fairfield County. His list includes a number of plants, specimens of which are not now definitely known from Ohio. Most of these have been included on his authority marked "Fide Bigelow." Many of them are plants whose general range is such as to make their occurrence highly probable and others are so distinctive that there could be no question of their proper determination. They are:

Ranunculus reptans L. "Nfd. to Pa. northward and westward."

Delphinium carolinianum "Va. N. C., and Ga., to Ark., Mo., Minn., and Sask."

Polygala incarnata. N. J. to S. Ont., Wis., Neb., and southw.

Trifolium reflexum. Included on state list but no Ohio specimens known to us.

Lithospermum officinale. A European escape not apparently establishing itself.

Trisetum palustre. "Mass. to Ill. and southw."

Panicularia acutiflora "Me. to Del. w. to Ohio."

Carex vesicaria. "E. Que. to B. C. s. to Pa., Gt. Lake region, etc."

*Bigelow, John M. *Florula Lancastriensis* or a catalog of nearly all the flowering and felicioid plants growing naturally within the limits of Fairfield County with notes of such as are medicinal. Proc. Med. Convent of Ohio at Columbus. May, 1841, pp. 49-79.

Some of Bigelow's plants belong to species that were not well understood at the time or whose identity the writer is inclined to question for other reasons. These are not included in the list; they are:

Ranunculus pusillus. "Near the coast S. N. Y. to Fla. and Tex., n. in the Miss. basin to Mo. and Tenn."

Viola cucullata. Determination doubtful.

Viola labradorica. Determination doubtful.

Viola sagittata. Determination doubtful.

Silene regia. Probably *S. rotundifolia*.

Oxalis stricta. Determination doubtful.

Acer spicatum. This is almost certainly absent now, but its habitat is such that it could hardly have become extinct. It is, however, difficult to imagine what could have been mistaken for it.

Lythrum hyssopifolium. "Near the coast Me. to N. J. Also on the Pacific Coast."

Antennaria dioica. Evidently a misdetermination. European species included in Gray's manual as "found by Geo. Thurber in 1844, but not since collected."

Hicoria glabra? Queried by Bigelow.

Scutellaria nervosa? Queried by Bigelow.

Chenopodium urbicum. No Ohio specimens extant.

Polygonum hirsutum? Queried by Bigelow.

Polygonum mite. A European species.

Rumex aquaticus. Synonymy doubtful.

Juncus polyccephalus. Synonymy doubtful.

"*Leimanthium virginicum* Willd." Synonymy doubtful.

Sparganium ramosum. Synonymy doubtful.

Potamogeton compressum. Synonymy doubtful.

Potamogeton gramineum. Synonymy doubtful.

Panicum nitidum. Synonymy doubtful.

Panicum involutum. Synonymy doubtful.

Aristida stricta? Queried by Bigelow.

Elymus villosus. Synonymy doubtful.

Isolepis capillaris. Synonymy doubtful.

Carex acuta. Synonymy doubtful.

Carex anceps. Synonymy doubtful.

Carex arida. Synonymy doubtful.

Carex bullata. "Mass. to Del., local." Formerly included in the Ohio list, but no Ohio specimens known.

Carex paniculata. Synonymy doubtful.

Carex sylvatica? Queried by Bigelow.

Carex tentaculata. Synonymy doubtful.

Carex tetanica? Queried by Bigelow.

Equisetum limosum? Queried by Bigelow.

He further reports a very considerable number of plants which are not otherwise definitely known from the region. Some of these, like *Chenopodium botrys*, are the commonest of plants, which have merely failed of notation by later workers, but many are very rare if, indeed, they are still to be found in the area. It does

not appear safe, however, to assert that any are extinct except a few species like *Cypripedium reginae* and *Dasyphora fruticosa*, which are so conspicuous that they could hardly have been overlooked if they still occurred. These are included in the list on Bigelow's authority.

Phylum, PTENOPHYTA

Class, FELICES, Ferns.

Subclass, EUSPORANGIATAE.

Order, *Ophioglossales*.

Family, **Ophioglossaceae**, Adder-tongue Family.

Ophioglossum vulgatum L. Adder-tongue. A few plants formerly grew in Stukey's swamp. (Sec. 4, Berne Twp.) I have not been able to find any since the station was lumbered in 1912.

Botrychium obliquum Muhl. Obligue Grape-fern.

Botrychium dissectum Spreng. Cutleaf Grape-fern.

Botrychium virginianum (L.) Sw. Virginia Grape-fern. Common.

Subclass, LEPTOSPORANGIATAE.

Felicales.

Osmundaceae, Royal-fern Family.

Osmunda regalis L. Royal fern.

Osmunda claytoniana L. Clayton fern.

Osmunda cinnamomea L. Cinnamon fern.

Polypodiaceae, Polypody Family.

Polypodium vulgare L. Common polypody. Common on the edges of cliffs.

Adiantum pedatum L. Maidenhair fern. Common.

Pteridium aquilinum (L.) Kuhn. Brake.

Pellaea atropurpurea (L.) Link. Purple Cliff-brake. Not known in our area and generally confined to limestone cliffs, but occurs on Blackhand Cliffs, near the village of Hanover, Licking Co.

Asplenium pinnatifidum Nutt. Pinnatifid Spleenwort. Common.

Asplenium platyneuron (L.) Oakes. (*A. ebouneum* Ait.). Ebony Spleenwort.

Asplenium trichomanes L. Maidenhair Spleenwort.

Asplenium pycnocarpan Spreng. (*A. angustifolium* Mx.). Narrow-leaf Spleenwort.

Asplenium montanum Willd. Mountain Spleenwort. In one hollow near Sugar Grove, at Pine Grove, on Little Rocky Branch, and at Cedar Falls.

Athyrium thelypteroides (Mx.) Desv. (*Asplenium achrostichoides* Sw.). Silvery Spleenwort.

Athyrium filixfoemina (L.) Roth. Lady Fern. No specimen.

Camptosorus rhizophyllus (L.) Link. Walking Fern. Commonly reputed a plant of calcareous regions, but common in our area. Not found, however, in the extremely humid hemlock ravines of the southern half of the area.

Polystichum achrostichoides (Mx.) Schott (*Aspidium*). Christmas Fern.

Dryopteris noveboracensis (L.) Gr. (*Aspidium*). New York Fern.

Dryopteris cristata (L.) Gr. (*Aspidium*). Crested Shield-fern.

- Dryopteris goldieana* (Hook.) Gr. (Aspidium). Goldie's Shield-fern. Not common.
Dryopteris marginalis (L.) Gr. (Aspidium). Marginal Shield-fern.
Dryopteris spinulosa (Retz.) Ktz. (Aspidium). Spinulose Shield-fern.
Dryopteris intermedia (Muhl.) Gr. (Aspidium).
Phegopteris phegopteris (L.) Und. (*P. polypodioides* Fee, *Dryopteris*). Long Beech-fern.
Phegopteris hexagonaptera (Mx.) Fee. (*Dryopteris*). Broad Beech-fern.
Filix bulbifera (L.) Und. (*Cystopteris*). Bulbous Bladder-fern.
Filix fragilis (L.) Und. (*Cystopteris*). Fragile Bladder-fern.
Woodsia obtusa (Spreng.) Torr. Obtuse Woodsia.
Dennstaedtia punctilobula (Mx.) Moore. (*Dieksonia*). Hay-scented fern. In this area never occurs in its customary habitat, but is limited to the faces of the cliffs.
Onoclea sensibilis L. Sensitive fern.

Phylum, CALAMOPHYTA

Class, EQUISETAEAE, Horsetails and Scouring-rushes.

Equisetales.

Equisetaceae.

- Equisetum hyemale* L. Common Scouring-rush.
Equisetum praelitum Raf (*E. robustum* A. Br.). Great Scouring-rush.
Equisetum arvense L. Field Horsetail.

Phylum, LEPIDOPHYTA

Class, LYCOPODIEAE, Lycopods.

Lycopodiales.

Lycopodiaceae, Club-moss Family.

- Lycopodium lucidulum* Mx. Shining Club-moss.
Lycopodium porophyllum, Lloyd & Underw. Rock Club-moss. Common on the cliffs. Easily separated from the last, but probably not distinct from it.
Lycopodium obscurum L. Tree Club-moss. Only a few widely scattered clumps, mostly in the southern half of the area.
Lycopodium clavatum L. Common Club-moss. A few clumps in the canyon above the "Gulf." Not otherwise known for more than a hundred miles to the northward.
Lycopodium complanatum L. Trailing Club-moss. Not common; confined to the southern half of the area or at least very rare around Sugar Grove.
 None of the Lycopods are known to extend southward or westward in Ohio beyond the present area.

Class, SELAGINELLEAE, Selaginellas.

Selaginellales.

Selaginellaceae, Selaginella Family.

- Selaginella rupestris* (L.) Spring. Rock Selaginella. Found only at Kettle Hills, on the northern boundary of the area, and on a high, bare knob south of Clear Creek in section 20, Good Hope Twp.

Phylum, STROBILOPHYTA

Class, CONIFERAE, Conifers.

Pinales.

Pinaceae, Pine Family.

Tsuga canadensis (L.) Carr. Hemlock. Common throughout the area, but occurs in pure stands only in the southern half.

Pinus rigida Mill. Pitch Pine. On the edge of its range.

Pinus virginiana Mill. Scrub Pine. On the edge of its range.

Juniperaceae, Juniper Family.

Juniperus virginiana L. Red Cedar. Common, but nowhere abundant.

Taxales.

Taxaceae, Yew Family.

Taxus canadensis Marsh. American Yew. Abundant in the Hemlock forest in the southern portion of the area, but absent from the northern portion.

Phylum, ANTHOPHYTA

Class, MONOCOTYLAE, Monocotyls.

Subclass, HELOBLIAE.

Alismales.

Alismaceae, Water-plantain Family.

Sagittaria latifolia Willd. Broad-leaf Arrowhead. Common in a few suitable habitats.

Alisma subcordatum Raf. (*A. plantago-aquatica* L.). American Water-plantain.

Scheuchzeriaceae, Arrow-grass Family.

Triglochin maritima L. Fide Bigelow.

Potamogetonaceae, Pond-weed Family.

Potamogeton zosterifolius L. Common Floating Pondweed. Swamps along the old canal.

Nymphaeales.

Nymphaeaceae, Water-lily Family.

Brasenia schreberi Gmel. B. purpurea Mx. Casp.). Water-shield. Fide Bigelow.

Nymphaea advena Ait. Spatterdock.

Subclass, SPADICIFLORAE.

Pandanales.

Sparganiaceae, Burr-reed Family.

Sparganium eurycarpum Englm. Broad-fruited Burr-reed. No herbarium specimen, noticed at the mouth of the first hollow north of Crystal Springs.

Sparganium americanum Nutt. Fide Bigelow.

Typhaceae, Cat-tail Family.

Typha latifolia L. Common Cat-tail. Along the old canal. No herbarium specimen.

*Arales.***Araceae**, Arum Family.

Acorus calamus L. Sweet-flag.

Spathema foetida (L.) Raf. (*Symplocarpus*). Skunk-cabbage. Common in suitable habitats. No specimen.

Arisaema triphyllum (L.) Torr. Jack-in-the-pulpit.

Arisaema dracontium (L.) Schott. Dragon-root.

Lemnaceae, Duck-weed Family.

Spirodela polyrhiza (L.) Schleid. Greater Duckweed.

Lemna trisulca L. Star-duckweed.

Lemna minor L. Lesser Duckweed.

Wolffia columbiana Karst. *Wolffia*. Known only from Buckeye Lake.

Subclass, GLUMIFLORAE.

*Graminales.***Cyperaceae**, Sedge Family.

Cyperus flavescens L. Yellow Cyperus.

Cyperus esculentus L. Fide Bigelow.

Cyperus speciosus Vahl. Fide Bigelow.

Cyperus strigosus L. Straw-colored Cyperus. Common. No specimen.

Cyperus filiculmis Vahl. Slender Cyperus.

Kyllingia pumila Mx.

Dulichium arundinaceum (L.) Britt.

Eleocharis obtusa Schultes. Fide Bigelow.

Eleocharis acicularis (L.) R. & S. Needle Spike-rush.

Eleocharis tenuis Schultes. Fide Bigelow.

Fimbristylis autumnalis (L.) R. & S.

Scirpus validus Vahl. (*S. laeustris* L.) Only in Buckeye Lake.

Scirpus atrovirens Muhl.

Scirpus polyphyllus Vahl.

Scirpus lineatus Mx. Reddish Bulrush. Fide Bigelow.

Scirpus cyperinus (L.) Kunth. Wool-grass.

Rhynchospora alba (L.) Vahl. Fide Bigelow.

Rhynchospora glomerata (L.) Vahl. Clustered Beaked-rush.

Scleria triglomerata Mx. Tall Nut-rush. Fide Bigelow.

Scleria paniciflora Muhl. Papillose Nut-rush. Fide Bigelow.

Carex asa-grayii Bailey (*C. grayii* Carey).

Carex bromoides Schkr. Fide Bigelow.

Carex cephalophora Muhl.

Carex conjuncta Boott.

Carex careyana Dewey. Fide Bigelow.

Carex costellata Britt. (*C. virescens* Muhl).

Carex erinita Lam.

Carex cristatella Britt. (*C. cristata* Schwein).

Carex davisii Schw. & Torr. Fide Bigelow.

- Carex decomposita* Muhl. Fide Bigelow.
Carex digitalis Muhl. Fide Bigelow.
Carex festuacea Schk. Fide Bigelow.
Carex frankii Kunth.
Carex gracillima Schw.
Carex hitecockiana Dewey. Fide Bigelow.
Carex hystericina Muhl. Fide Bigelow.
Carex intumescens Rudge. Fide Bigelow.
Carex jamesii Schw.
Carex lanuginosa Mx. Fide Bigelow.
Carex laxiflora Lam.
Carex laxiflora varians Bailey.
Carex leptalea Wahl.
Carex lupulina Muhl.
Carex lupulina var. *pedunculata* Dewey.
Carex lurida Wahl.
Carex oligocarpa Schk. Fide Bigelow.
Carex pennsylvanica Lam.
Carex plantaginea Lam.
Carex platyphylla Carey.
Carex prasina Wahl.
Carex pseudo-cyperus L. Fide Bigelow.
Carex pubescens Muhl. Fide Bigelow.
Carex retroflexa Muhl.
Carex riparia Curtis. Fide Bigelow.
Carex rosea Schkr.
Carex rosea radiata Dewey.
Carex shortiana Dew. & Torr. Fide Bigelow.
Carex sparganioides Muhl.
Carex squarrosa L.
Carex stellulata Goodn. Fide Bigelow.
Carex stipata Goodn.
Carex straminea Willd. Fide Bigelow.
Carex tribuloides Schkr.
Carex triiceps Mx.
Carex tuckermanii Dewey.
Carex vesicaria L. Fide Bigelow. Not otherwise known in Ohio.
Carex vulpinoidea Mx.
Carex willdenovii Schk. Fide Bigelow.

Graminaceae, Grass Family.

- Bromus ciliatus* L. Wood Chess.
Bromus purgans L. Pubescent Brome-grass.
Bromus tectorum L. Downy Brome-grass.
Bromus secalinus L. Cheat. Common. No specimens.
Bromus racemosus L. Upright Chess.
Festuca octoflora Walt. (*F. tenella*.) Slender Fescue-grass.

- Panicularia acutiflora* (Torr.) Ktze. (Glyceria). Fide Bigelow. Given by the manuals from the state as reaching Ohio, but authentic specimens are not known to us.
- Panicularia fluitans* (L.) Ktz. (*G. septentrionalis* Hitch.). Floating Manna-grass. Fide Bigelow.
- Panicularia torreyana* (Spreng) Merr. Long Manna-grass. Otherwise known only from the northeastern counties of the state.
- Panicularia nervata* (Willd.) Ktz. Nerved Manna-grass.
- Panicularia pallida* (Torr.) Ktze. Fide Bigelow. Now known only from Ottawa Co.
- Poa annua* L. Low Spear-grass.
- Poa pratensis* L. Kentucky Blue-grass. Common. No specimen.
- Poa compressa* L. Wire-grass.
- Poa trivialis* L. Roughish Meadow-grass. Fide Bigelow.
- Poa triflora* Gilib. (*P. flava* L.) Fowl Meadow-grass.
- Poa sylvestris* Gray.
- Poa brevifolia* Muhl. Short-leaf Spear-grass.
- Dactylis glomerata* L. Orchard-grass. Common. No specimen.
- Eragrostis pilosa* (L.) Beauv. Fide Bigelow.
- Eragrostis frankii* Steud. Frank's Eragrostis.
- Eragrostis major* Host. (*E. megastachya*). Stinking Eragrostis.
- Eragrostis capillaris* (L.) Nees. Fide Bigelow.
- Eragrostis pectinacea* (Mx.) Steud. Purple Eragrostis.
- Eragrostis hypnoides* (Lam.) B. S. P. Fide Bigelow.
- Sphenopoli obtusata* (Mx.) Scribn. (*Eatonia*). Blunt-seeded Eaton-grass. Fide Bigelow. No specimens in State herbarium.
- Sphenopoli pallens* (Spreng.) Scribn. Tall Eaton-grass.
- Sphenopoli nitida* (Spreng.) Scribn.
- Phragmites phragmites* (L.) Karst. (*P. communis* Trin.) Reed. Fide Bigelow.
- Danthonia spicata* (L.) Beauv. Wild Oat-grass.
- Trisetum pennsylvanicum* (L.) Beauv. Marsh False-oats. Fide Bigelow. No specimens in State herbarium.
- Deschampsia flexuosa* (L.) Trin. Fide Bigelow. Now known only from Portage Co.
- Notholaus lanatus* (L.) Nash. (*Holcus*). Velvet-grass.
- Lolium perenne* L. Darnel.
- Hordeum jubatum* L. Squirrel Tail-grass. Common. No specimen.
- Elymus virginicus* L. Virginia Wild-rye.
- Elymus striatus* Willd. Fide Bigelow.
- Hystrix hystrix* (L.) Millsp. (*H. patula*). Bottle Brush-grass. Fide Bigelow.
- Eleusine indica* Gaertn. Wire-grass.
- Agrostis alba* (L.) White. Bent-grass.
- Agrostis schweinitzii* Trin. (*A. perennans*) Thin-grass.
- Agrostis hyemalis* (Walt.) B. S. P. Hair-grass.
- Cinna arundinacea* L. Wood Reed-grass.
- Alopocurus geniculatus* L. Marsh Fox-tail. Fide Bigelow.
- Phleum pratense* L. Timothy.
- Muhlenbergia mexicana* (L.) Trin. Meadow Muhlenbergia.
- Muhlenbergia tenuiflora* (Willd.) B. S. P. Slender Muhlenbergia.

- Muhlenbergia diffusa* Schreb. Drop-seed Grass.
Brachylytrum erectum Schreb.
Aristida dichotoma Mx. Poverty Grass.
Savastana odorata (L.) Scrib. (*Hierachloa borealis* R. & S.). Vanilla Grass. Fide Bigelow.
Anthoxanthum odoratum L. Sweet Vernal-grass. Fide Bigelow.
Panicum stipitatum Nash.
Panicum virgatum L. Switch Grass.
Panicum capillare L. Tumble Grass.
Panicum linearifolium Scrib.
Panicum dichotomum L.
Panicum microcarpon Muhl.
Panicum lindheimeri Nash. Known only from Ashtabula and Hocking Counties.
Panicum huachucae Ashe.
Panicum sphaerocarpon Ell.
Panicum polyanthes Schultes.
Panicum commutatum Schultes.
Panicum ashei Pear.
Panicum clandestinum L.
Panicum latifolium L.
Syntherisma sanguinalis (L.) Dulac (*Digitaria* Scop.). Crab-grass.
Syntherisma ischaemum (Schraeb) Nash. (*S. linearis*, *Digitaria humifusa* Pers.). Small Crab-grass.
Echinochloa crus-galli (L.) Beauv. Barnyard Grass.
Chaetochloa viridis (L.) Scrib. (*Setaria* L.). Green Foxtail.
Chaetochloa glauca (L.) Scrib. Yellow Foxtail is doubtless also common, but there is no specimen nor definite record.
Homalocenchrus oryzoides (L.) Pool. (*Leersia*). Rice Cut-grass. Fide Bigelow.
Homalocenchrus virginicus (Willd.) Britt. (*Leersia*). Cut-grass. Fide Bigelow.
Zizania aquatica L. (*Zizania palustris* L. of Gr. Man). Wild Rice. Along the old canal in a pond about a mile above Logan.
Sorghastrum nutans (L.) Nash. Indian-grass. Fide Bigelow.
Andropogon scoparius Mx. Broom Beard-grass.
Andropogon virginicus L. Virginia Beard-grass.
Andropogon furcatus Muhl. Forked Beard-grass.

Subclass, LILIFLORAE.

Liliales.

Liliaceae, Lily Family.

Subfamily, LILIATAE.

- Heamerocallis fulva* L. Day-lily.
Allium tricoccum Ait. Wild Leek. No specimen.
Allium canadense L. Meadow Garlic. Fide Bigelow.
Lilium canadense L. Yellow Lily.
Erythronium americanum Ker. Yellow Spring-lily.
Erythronium albidum Nutt. White Spring-lily.

Quamasia hyacinthina (Raf.) Britt. (*Camassia esculenta*). Wild Hyacinth. Fide Bigelow.

Alettris farinosa L. Colic Root. Fide Bigelow.

Subfamily, MELANTHATAE.

Chamaelirium luteum (L.) Gr. *Chamaelirium*. Fide Bigelow.

Veratrum woodii Robbins. Wood's False Hellebore. Fide Bigelow. Now known only from Auglaize County.

Uvularia perfoliata L. Perfoliate Bellwort.

Subfamily, TRILLIATAE.

Medeola virginica L. Indian Cucumber-root.

Trillium sessile L. Sessile Wake-robin. No specimen.

Trillium grandiflorum (Mx.) Salisb. Large-flowered Wake-robin.

Trillium erectum L. Ill-scented Wake-robin.

Subfamily, CONVALLARIATAE.

Asparagus officinalis L. Asparagus. Fide Bigelow.

Vagnera racemosa (L.) Morong. (*Smilacina*). False Spikenard.

Vagnera stellata (L.) Desf. (*Smilacina*). Stellate Solomon's Seal. Fide Bigelow.

Unifolium canadense (Desf.) Greene (*Mianthemum*). Wild Lily-of-the-valley.

Polygonatum biflorum (Walt.) Ell. (*Salomonina*). Common Solomon's Seal. No specimen.

Polygonatum commutatum (R. & S.) Ell. (*Salomonina*). Large Solomon's Seal.

Smilacaceae, Smilax Family.

Smilax herbacea L. Carrion-flower.

Smilax ecirrhata (Englm.) Wats. Upright Smilax.

Smilax glauca Walt. Saw-brier.

Smilax rotundifolia L. Greenbrier.

Smilax hispida Muhl. Hispid Greenbrier. No specimen.

Pontederiaceae, Pickerel-weed Family.

Heteranthera dubia (Jacq.) MacM. Water Star-grass. Fide Bigelow.

Commelinaceae, Spiderwort Family.

Tradescantia virginica L. Spiderwort.

Juncaceae, Rush Family.

Juncus effusus L. Common Rush.

Juncus tenuis Willd. Slender Rush.

Juncus acuminatus Mx. Sharp-fruited Rush.

Juncoides caroliniae (Wats.) (*Luzula saltuensis* Fernald). Hairy Wood-rush. On the edge of its range, known otherwise only in northern Ohio.

Juncoides campestre (L.) Ktze. (*Luzula*). Common Wood-rush.

Xyridaceae, Yellow-eyed Grass Family.

Xyris caroliniana Walt. Fide Bigelow. No specimens known from the state.

*Iridales.***Amaryllidaceae**, Amaryllis Family.

Hypoxis hirsuta (L.) Coville. Yellow Star-grass.

Iridaceae, Iris Family.

Iris versicolor L. Large Blue Flag. Common in the marshes around Lancaster. No specimen.

Iris cristata Ait. Crested Dwarf Iris. A few stations, especially at the tops of waterfalls, e. g., at the Rock Bridge, in the southern section of the area.

Sisyrinchium graminoides Bick. Blue-eyed Grass. No specimen.

Dioscoreaceae, Yam Family.

Dioscorea villosa L. Wild Yam. No specimen.

*Orchidales.***Orchidaceae**, Orchid Family.

Fissipes acaulis (Ait.) Sm. (Cypripedium). Stemless Lady-slipper. On the edge of its range, common on the uplands, but not nearly so abundant as in other parts of its range.

Cypripedium reginae Walt. (C. spectabile, C. hirsutum). Showy Lady's-slipper. Fide Bigelow. Almost certainly extinct now.

Cypripedium parviflorum var. *pubescens* (Willd.) Knight. (C. hirsutum). Yellow Lady's-slipper. Occasional in the Liriodendron forest.

Galeorchis spectabilis (L.) Rydb. (Orchis). Showy Orchid.

Perularia flava (L.) Rydb. (?) Fide Bigelow. Queried by Bigelow.

Lysias orbiculata (Pursh) Rydb. (Habenaria). Large Round-leaf Orchid. Fide Bigelow. Known only from three other counties.

Blephariglottis lacera (Mx.) Farw. (Habenaria). Lacerate Orchid. A few individuals only in Stukey's Swamp. I have not been able to find any since the lumbering of 1912.

Blephariglottis peramoena (Gr.) Rydb. Fringeless Purple Orchid. Occasional in the Liriodendron forest in the southern portion of the area. Not seen around Sugar Grove.

Pogonia ophioglossoides (L.) Ker. Rose Pogonia. Fide Bigelow. Not now known south of Buckeye Lake.

Isotria verticillata (Willd.) Raf. On the edge of its range. Common in the pine woods, but never seen in flower and only once in fruit by the writer.

Limnoderum tuberosum L. (Calopogon puchellus). Only from Buckeye Lake.

Ibidium cernua (L.) House. (Gynostachys, *Spiranthes*). Nodding Lady's-tresses. Common. No specimen.

Ibidium beckii (Lidl.) House. (*Spiranthes simplex*). Little Lady's-tresses. A single specimen from near Lancaster, J. E. Hyde. The only Ohio station.

Ibidium gracilis (Biegl) House. (*Spiranthes*). Slender Lady's-tresses. Unlike most of the orchids, this plant withstands the clearing of the forest very well and is fairly common in pastures and along the road-side.

Peramium pubescens (Willd.) MacM. (Goodyera, *Epipactis*). Downy Rattlesnake Plantain. Common but restricted to situations not covered with autumn leaves.

Malaxus unifolia Mx. (*Microstylis*, *Achroanthus*). Green Adder's-mouth. Inconspicuous but not uncommon. Known in Ohio only from the present area and Wayne County.

Aplectrum spieatum (Walt.) B. S. P. (*A. hyemale*). Putty Root. Fide Bigelow.

Liparis lilifolia (L.) Rich. (*Leptorehis*). Large Twayblade.

Corallorhiza odontorhiza (Willd.) Nutt. Small-flowered Coral-root. Rather common in the fall.

Corallorhiza maculata (C. multiflora) Nutt. Large Coral-root.

Class, DICOTYLAE, Dicotyls.

Subclass, THALAMIFLORAE.

Ranales.

Magnoliaceae, Magnolia Family.

Magnolia acuminata L. Cucumber Tree. Fide Bigelow.

Liriodendron tulipifera L. Tuliptree.

Annonaceae, Custard-apple Family.

Asimina triloba (L.) Dunal. Pawpaw. No specimen.

Ranunculaceae, Crowfoot Family.

Ranunculus reptans L. (*R. flammula* var.). Fide Bigelow. Not now known from Ohio.

Ranunculus abortivus L. Kidney-leaf Crowfoot. No specimen.

Ranunculus sceleratus L. Celery-leaf Crowfoot. No specimen.

Ranunculus recurvatus Poir.

Ranunculus aeris L. Tall Buttercup. A single plant at the quarry siding, where ears are cleaned, Rockbridge.

Ranunculus pennsylvanicus L. Bristly Buttercup.

Ranunculus septentrionalis Poir. Swamp Buttercup.

Ranunculus hispidus Mx. Hispid Buttercup.

Trollius laxus Salisb. American Globe-flower. Fide Bigelow. Known only from Columbiana and Stark Counties.

Aquilegia canadensis L. Common but not so abundant nor so thrifty as on the limestone cliffs near Columbus.

Delphinium tricorne Mx. Dwarf Larkspur. Not seen within the area itself.

Delphinium carolinianum Walt. (*D. azureum*). Given by Bigelow. Not otherwise known in Ohio.

Anemone virginiana L. Virginia Anemone.

Anemone canadensis L. Canada Anemone.

Hepatica hepatica (L.) Karst. (*H. triloba*). Round-lobed Hepatica. Only in the less steep ravines. The change from *H. acuta* to *H. hepatica* is very striking as one goes south of our area into Vinton County.

Hepatica acutiloba D. C. (*H. acuta*.) Sharp-lobed Hepatica. In the deeper canyons. The common form.

Clematis virginiana L. Common Virgin's Bower.

Viorna viorna (L.) Sm. (*Clematis*). Leather flower.

Caltha palustris L. Marsh Marigold.

Actea alba (L.) Mill. White Baneberry.

Cimicifuga racemosa (L.) Nutt. Black Cohosh. Often a dominant plant in the under barbage around Sugar Grove. Seldom abundant further south.
Isopyrum bibernatum (Raf.) T. & G. False Rue anemone. Fide Bigelow. I doubt if this can be found in the area proper. It is conspicuous by its absence.
Syndesmon thalictroides (L.) Hohhm. (Anemonella). Rue Anemone.
Thalictrum dioicum L. Early Meadow-rue.
Thalictrum dasycarpum Fisch. & Lall. (T. purpurascens). Purplish Meadow-rue.
Thalictrum polygamum Muhl. Tall Meadow-rue. No specimen.

Parnassiaceae, Grass-of Parnassus Family.

Parnassia caroliniana Mx. Carolina Grass-of-Parnassus. A specimen from Lancaster, J. E. Hyde.

Ceratophyllaceae, Hornwort Family.

Ceratophyllum demersum L. Hornwort.

Berberidaceae, Barberry Family.

Caulophyllum thalictroides (L.) Mx. Blue Cohosh. No specimen.
Jeffersonia diphylla (L.) Pers. No specimen.
Podophyllum peltatum L. May-apple. No specimen.

Menispermaceae, Moonseed Family.

Menispermum canadense L. Moonseed. No specimen.

Lauraceae, Laurel Family.

Sassafras sassafras (L.) Karst. (S. officinale). Sassafras.
Benzoin aestivale (Nees.) Spicebush.

Brassicales.

Papaveraceae, Poppy Family.

Sanguinaria canadensis L. Bloodroot. Strangely absent from most of the southern section, but present in Little Rocky Branch. Common in northern section. No specimen.
Chelidonium majus L. Celendine. No specimen.

Fumariaceae, Fumitory Family.

Bienculla eucularia (L.) Millsp. (Dicentra). Dutchman's Breeches. No specimen.
Bienculla canadensis (Goldie) Millsp. (Dicentra). Squirrel Corn. No specimen.
Capnoides sempervirens (L.) Borek. (Corydalis). Pink Corydalis.

Brassicaceae, Mustard Family.

Draba verna L. Vernal Whitlaw-grass. No specimen.
Camelina sativa (L.) Krantz. Common Toad-flax. Fide Bigelow.
Bursa bursa-pastoris (L.) Britt. (Capsella). Shepherd's Parse. No specimen.
Armoracia armoracia (L.) Britt. (Roripa). Horseradish.
Radicula palustris (L.) Moench. Marsh Yellow Cress.
Lepidium virginicum L. Pepper-grass.
Cheirinia cheiranthoides (L.) Link. Worm-seed Mustard. Fide Bigelow.
Erysimum officinale L. (Sisybrium). Hedge Mustard. No specimen.

- Barbarea barbarea* (L.) MacM. (*B. vulgaris*). Winter Cress. No specimen.
Arabis hirsuta (L.) Scop. Hairy Rock-cress.
Arabis laevigata (Muhl.) Torr. Smooth Rock-cress.
Arabis canadensis L. Sickie Pod. Fide Bigelow.
Arabis glabra (L.) Bernh. Tower Mustard. Fide Bigelow.
Cardamine hirsuta L. Hairy Bitter-cress.
Cardamine pennsylvanica Muhl. Pennsylvania Bitter-cress.
Cardamine parviflora L. Small-flowered Bitter-cress.
Cardamine bulbosa (Schreb.) B. S. P. Bulbous Bitter-cress.
Cardamine rotundifolia Mx. Round-leaf Bitter-cress. Fide Bigelow. Now known only from Belmont and Noble counties.
Dentaria laciniata Muhl. Cut-leaf Toothwort.
Dentaria diphylla Mx. Two-leaf Toothwort. At the head of Laurel Run and in one or two other stations.
Dentaria heterophylla Nutt. Common in the deep canyons of the southern half of the area. Not around Sugar Grove.
Brassica nigra (L.) Koch. Black Mustard.

Geraniales.

Geraniaceae, Geranium Family.

- Geranium maculatum* L. Wild Geranium.
Geranium carolinianum L. Carolina Crane's-bill. Fide Bigelow.

Oxalidaceae, Wood-sorrel Family.

- Oxalis corniculata* L. No specimen.
Oxalis cymosa Small.
Oxalis grandis Small.
Oxalis violacea L. No specimen.

Limnanthaceae, False-Mermaid Family.

- Floerkea proserpinacoides* Willd. False-Mermaid. Fide Bigelow.

Linaceae, Flax Family.

- Linum virginianum* L. Yellow Flax.

Balsamiaceae, Jewelweed Family.

- Impatiens biflora* Walt. Spotted Jewelweed. No specimen.
Impatiens pallida Nutt. (*I. aurea*). Yellow Jewelweed. No specimen.

Rutaceae, Rue Family.

- Xanthoxylum americanum* Mill. Prickly Ash. Fide Bigelow.

Simarubaceae, Ailanthus Family.

- Ailanthus glandulosa* Desf. Tree-of-Heaven. No specimen.

Polygalaceae, Milkwort Family.

- Polygala verticillata* L. Whorled Milkwort.
Polygala ambigua Nutt. Loose-spike Milkwort.
Polygala viridescens L. Purple Milkwort.

Polygala senega L. Seneca Snakeroot. Fide Bigelow.

Polygala incarnata L. Pink Milkwort. Fide Bigelow. No authentic specimens are now known from Ohio.

Euphorbiaceae, Spurge Family.

Acalypha virginica L. Virginia Three-seeded Mercury.

Acalypha graciliens Gr. Slender Three-seeded Mercury.

Tithymalus lathrus (L.) Hill. (Euphorbia). Caper Spurge. Known from Hocking County only.

Tithymalus obtusatus (Pursh) K. & G. Blunt-leaf Spurge. Fide Bigelow.

Tithymalopsis corallata (L.) K. & G. (Euphorbia). Flowering Spurge.

Chamaesyce preslii (Guss) Arth. (Euphorbia nutans). Nodding Spurge.

Chamaesyce maculata (L.) Small. (Euphorbia). Milk Spurge.

Callitrichaceae, Water Starwort Family.

Callitriche sp. Fide Bigelow.

Malvales.

Malvaceae, Mallow Family.

Abutilon abutilon (L.) Rusby (*A. theophrasti* Medic.). Velvet Leaf. Common. No specimen.

Malva rotundifolia L. Low Mallow. No specimen.

Napaea dioica L. Glade Mallow.

Sida spinosa L. Prickly Sida. No specimen.

Hibiscus militaris Cav. Fide Bigelow.

Tiliaceae, Linden Family.

Tilia americana L. Basswood.

Guttiferales.

Hypericaceae, St. John's-wort Family.

Aseron hypericoides L. St. Andrew's Cross.

Hypericum ascyron L. Fide Bigelow.

Hypericum prolificum L. Shrubby St. John's-wort.

Hypericum punctatum Lom. (*H. maculatum*). Spotted St. John's-wort. Fide Bigelow.

Hypericum mutilum L. Dwarf St. John's-wort.

Hypericum drummondii (Grev. & Hook.) T. & G. Drummond's St. John's-wort.

A single station on the top of the cliff overlooking the junction of "The Gulf" with the Canyon of Clear Creek, fairly numerous in 1909, less so in 1910 and 1911. The extreme eastern edge of its range.

Sarothra gentianoides L. Orange Grass. Fide Bigelow.

Cistaceae, Rock-rose Family.

Crocanthemum majus (L.) Britt. (*Helianthemum*). Hoary Frost-weed.

Leechea minor L. Thyme-leaf Pinweed.

Leechea racemulosa Mx. Oblong-fruited Pinweed.

Violaceae, Violet Family.

Cubelium concolor (Forst.) Raf. (*Hybanthus*). Green Violet.

- Viola canadensis* L. Canada Violet.
Viola pubescens Ait. Hairy Yellow Violet.
Viola striata Ait. Striped White Violet.
Viola rostrata Pursh. Long-spurred Violet. Common. No specimen.
Viola rotundifolia Mx. Round-leaf Yellow Violet. Collected by Kellerman near the Rock House, but seen by the writer only in Little Rocky Branch.
Viola pallens (Banks) Brain. (*V. leontiana*). Woodland White Violet.
Viola blanda Willd. Sweet White Violet.
Viola lanceolata L. Lance-leaf Violet. A single plant, collected at Sugar Grove by Miss Lied.
Viola affinis Le C. (*V. obliqua*). Thin-leaf Violet.
Viola papilionacea Pursh. Common Blue Violet.
Viola hirsutula Brainerd. Southern Wood Violet. Not collected from any other area of the state.
Viola palmata L. Early Blue Violet.

Passifloraceae, Passion-flower Family.

- Passiflora lutea* L. Yellow Passion-flower. Fairly common, but does not flower freely; on the northern edge of its range.

Subclass, CENTROSPERMAE.

Caryophyllales.

Caryophyllaceae, Pink Family.

Subfamily, ALSINATAE.

- Alsine media* L. (*Stellaria*). Common Chickweed. No specimen.
Alsine pubera (Mx.) Britt. (*Stellaria*). Great Chickweed.
Alsine longiflora (Muhl.) Britt. (*Stellaria*). Long-leaf Stichwort. No specimen.
Cerastium viscosum L. Mouse-ear Chickweed. Fide Bigelow.
Cerastium vulgatum L. Larger Mouse-ear Chickweed.
Cerastium longipedunculatum Muhl. (*C. nutans*). Nodding Chickweed. Fide Bigelow.
Arenaria sepyllifolia L. Thyme-leaf Sandwort.
Spergula arvensis L. (?) Fide Bigelow. (Queried by Bigelow.) Now known only from Lake County.

Subfamily, CARYOPHYLLATAE.

- Agrostema githago* L. Corn Cockle.
Silene stellata (L.) Ait. Starry Campion.
Silene virginica L. Fire Pink.
Silene rotundifolia Nutt. Round-leaf Catchfly. Known only from Hocking and Jackson Counties. Common on the cliffs in the southern portion of the area up to Cantwell Cliffs, which is, so far as I have found, the northernmost limit of its range; entirely lacking around Sugar Grove.
Silene antirrhina L. Sleepy Catchfly.
Silene noctiflora L. Fide Bigelow.
Lychnis coronaria (L.) Desv. Mullein Pink.
Saponaria officinalis L. Bouncing Bet.

Aizoaceae, Carpetweed Family.

Mullugo verticillata L. Carpetweed.

Portulacaceae, Portulaca Family.

Claytonia virginica L. Spring Beauty. No specimen.

Portulaca oleracea L. Purslane. No specimen.

Phytolaccaceae, Pokeweed Family.

Phytolacca americana L. (*P. decandra*). Pokeweed. Common. No specimen.

Chenopodiales.**Corrigiolaceae**, Whitlow-wort Family.

Anychia canadensis (L.) B. S. P. No specimen.

Amaranthaceae, Amaranth Family.

Amaranthus retroflexus L. Rough Pigweed.

Amaranthus hybridus L. Fide Bigelow.

Chenopodiaceae, Goosefoot Family.

Chenopodium album L. Lamb's-quarters. No specimen.

Chenopodium hybridum L. Maple-leaf Goosefoot.

Chenopodium ambrosioides L. Mexican Tea.

Chenopodium botrys L. Fide Bigelow.

Polygonales.**Polygonaceae**, Buckwheat Family.

Rumex acetosella L. Sheep Sorrel. Common. No specimen.

Rumex verticillatus L. Swamp Dock. Fide Bigelow.

Rumex altissimus Wood. Tall Dock.

Rumex britannica L. Great Water Dock. Old canal, about a mile above Logan.

Rumex crispus L. Curly Dock.

Rumex obtusifolius L. Broad-leaf Dock. Common. No specimen.

Tinaria convolvulus (L.) W. & M. Black Bindweed. Fide Bigelow.

Tinaria scandens (L.) Sm. Climbing False Buckwheat. No specimen.

Tracaulon sagittatum (L.) Sm. Arrow-leaf Tear-thumb.

Tracaulon arifolium (L.) Raf. Halberd-leaf Tear-thumb. In a few stations around Sugar Grove, the edge of its range.

Fagopyrum fagopyrum (L.) Karst. (*F. esculentum*). Buckwheat. Commonly escaped. No specimens.

Persicaria amphibia (L.) S. F. G. (*Polygonum*). Water Knotweed.

Persicaria pennsylvanica (L.) Sm. Pennsylvania Knotweed. Abundant. No specimen.

Persicaria persicaria (L.) Sm. Lady's Thumb.

Persicaria hydropiperoides (Mx.) Sm. Mild Smartweed.

Persicaria punctata (Ell.) Sm. (*P. aere*). Water Smartweed.

Persicaria orientalis (L.) Spach. Prince's Feather.

Tovaria virginiana (L.) Raf. (*Polygonum*). Virginia Knotweed.

Polygonum aviculare L. Doorweed. No specimen.

Polygonum erectum L. Erect Knotweed.

Polygonum tenue Mx. Slender Knotweed. Fide Bigelow.

Piperales.

Saururaceae, Lizard's-tail Family.

Saururus cernuus L. Lizard's Tail.

Subclass, CALYCIFLORAE.

Rosales.

Rosaceae, Rose Family.

Subfamily, ROSATAE.

Geum vernum (Raf.) T. & G. Spring Avens. No specimen.

Geum canadense Jacq. White Avens. No specimen.

Geum strictum Ait. Yellow Avens.

Dasyphora frutescens (L.) Rydb. Shrubby Cinquefoil. Fide Bigelow. Almost certainly extinct at present.

Potentilla canadensis L. Common Five-finger. No specimen.

Potentilla monspeliensis L. Rough Cinquefoil.

Potentilla recta L. Upright Cinquefoil.

Waldsteinia fragarioides (Mx.) Tratt. Barren Strawberry. Fide Bigelow. Certainly very rare.

Fragaria virginiana Duchesne. Virginia Strawberry.

Fragaria vesca americana Porter. American Wood Strawberry. No specimen.

Fragaria vesca L. (White-fruited variety.) In the lower part of Kunkle's Hollow.

Rubus odoratus L. Purple Flowering Raspberry.

Rubus triflorus Rich. (*R. americanus*). Dwarf Raspberry.

Rubus occidentalis L. Black Raspberry. Common; as is also the forma *pallidus*, with amber fruit. No specimens.

Rubus allegheniensis Port. High Bush Blackberry. Has also recently been called

Rubus villosus, *R. canadensis*, and *R. nigrobaccus*.

Rubus procumbens Muhl. Dewberry. Has also been known recently as *R. canadensis*, and *R. villosus*.

Porteranthus stipulatus (Muhl) Britt. (*Gillenia*). American Ipecac. Fide Bigelow.

Filipendula rubra (Hill) Rob. (*Ulmaria*). Queen-of-the-Prairie. Fide Bigelow.

Opulaster opulifolius (L.) Ktze. (*Physocarpus*). Nine Bark. Fide Bigelow.

Spiraea alba Du Roi. (*S. salicifolia*). Narrow-leaf Spiraea. Fide Bigelow.

Spiraea tomentosa L. Hardhack.

Aruncus aruncus (L.) Karst. (*A. sylvestris*). Goat's Beard.

Rosa setigera Mx. Prairie Rose.

Rosa carolina L. Swamp Rose.

Rosa virginiana Mill. (*R. humilis*). Low Rose.

Rosa rubiginosa L. Sweetbrier (Rose). Fide Bigelow.

Agrimonia gryposepala Wallr. Common Agrimony. Fide Bigelow.

Agrimonia parviflora Soland. Small-flowered Agrimony.

Sanguisorba canadensis L. American Burnet. Fide Bigelow.

Subfamily, MALATAE.

- Malus coronaria* (L.) Mill. (*Pyrus angustifolia*). Narrow-leaf Crab-apple.
Malus glaucescens Rehd. (*P. coronaria*). American Crab-apple.
Malus malus (L.) Britt. (*Pyrus*). Common Apple.
Aronia melanocarpa (Mx.) Britt. (*Pyrus*, *A. nigra*). Black Chokeberry. Not uncommon among the Huckleberries.
Amalanchier canadensis (L.) Med. Service Berry Shad Bush.
Amalanchier botryapium (L. f.) T. & G. Fide Bigelow.
Crataegus crus-galli L. Cockspur Thorn. No specimen.
Crataegus punctata Jacq. Large fruited Thorn.
Crataegus coccinea L. Scarlet Thorn.
Crataegus succulenta Schred. (*C. macrocarpa*). Long-spine Thorn.

Subfamily, AMYGDALATAE.

- Prunus virginiana* L. (*P. serotina*, *Padus*) Wild Black Cherry.
Prunus nana Du Roi. (*P. virginiana*, *Padus*) Choke Cherry.
Prunus americana Marsh. Wild Plum.
Amygdalus persica L. Peach.

Fabaceae, Pea Family.

Subfamily, CASSIATAE.

- Cercis canadensis* L. Redbud. Common all around the area and in the northern section but very rare in the southern section. A satisfactory hypothesis to account for this and some similar anomalies is beyond the imagination of the writer, but the absence of the redbud is exceedingly striking in the spring, when a single flowering tree can be seen for miles, so that there can be no question of the fact. No specimens.
Chamaecrista nictitans (L.) Moench. Sensitive Pea.
Chamaecrista fasciculata (Mx.) Greene. (*Cassia chamaecrista*). Partridge Pea.
Cassia marylandica L. Wild Senna.
Gleditsia triacanthos L. Honey Locust.
Gymnocladus dioica (L.) Koch. Coffee-bean. This species reaches the edge of its range immediately to the west of the Sugar Grove area. After some search a single tree was found close by the Leaning Rock on the Clear Creek Road. No specimen.

Subfamily, FABATAE.

- Baptisia tinctoria* (L.) R. Br. Blue Wild-indigo. Fide Bigelow.
Baptisia leucantha T. & G. Large White Wild-indigo. Fide Bigelow.
Melilotus alba Desv. White Sweet-clover.
Trifolium procumbens L. Low Hop-clover.
Trifolium pratense L. Red Clover. No specimen.
Trifolium reflexum L. Buffalo Clover. Fide Bigelow. Known only from Lawrence County.
Trifolium hybridum L. Alsike Clover.
Trifolium repens L. White Clover. No specimen.
Psoralea obobrychis Nutt. Fide Bigelow.
Cracca virginiana L. (*Tephrosia*) Goat's-rue.

- Robinia pseudacacia* L. Black Locust. No specimen.
Robinia viscosa Vent. Clammy Locust.
Astragalus carolinianus L. Carolina Milk-vetch. No specimen.
Stylosanthes biflora (L.) B. S. P. (*S. elatior*). Pencil Flower. A few specimens on Queer Creek. Also recorded for Fairfield County by Bigelow. The northern edge of its range.
Meibomia nudiflora (Desmodium) (L.) Ktze. Naked-flowered Tick-trefoil.
Meibomia grandiflora (L.) Ktze. (Desmodium). Pointed-leaf Tick-trefoil. Fide Bigelow.
Meibomia michauxii Vail (*Desmodium rotundifolium*). Prostrate Tick-trefoil.
Meibomia canescens (L.) Ktze. (Desmodium). Hoary Tick-trefoil.
Meibomia bracteosa (Mx.) Ktze. (*Desmodium cuspidatum*). Large-bracted Tick-trefoil. Queer Creek Valley. No specimen.
Meibomia paniculata (L.) Ktze. (Desmodium) Panicle Tick-trefoil.
Meibomia viridiflora (L.) Ktze. (Desmodium) Velvet-leaf tick-trefoil.
Meibomia dillenii (Darl.) Ktze. (Desmodium) Dillen's Tick-trefoil.
Meibomia canadensis (L.) Ktze. (Desmodium) Canadian Tick-trefoil. Fide Bigelow.
Meibomia rigida (Ell.) Ktze. (Desmodium) Rigid Tick-trefoil. Known from Fairfield and Paulding Cos. only.
Meibomia marylandica (L.) Ktze. (Desmodium) Maryland Tick-trefoil. Known only from Fairfield and Hocking Counties.
Meibomia obtusa (Muhl.) Vail. (*Desmodium ciliare*). Ciliate Tick-trefoil. Old fields e. g. above Stukey's swamp; no specimen.
Lespedeza repens (L.) Bart. Creeping Bush-clover.
Lespedeza procumbens Mx. Trailing Bush-clover.
Lespedeza violacea (L.) Pers. Violet Bush-clover.
Lespedeza frutescens (L.) Britt.
Lespedeza hirta (L.) Ell. Hairy Bush-clover.
Lespedeza capitata Mx. Round-headed Bush-clover.
Vicia caroliniana Walt. Carolina Vetch. No specimen.
Lathrus palustris L. Marsh Vetchling. Fide Bigelow.
Falcata comosa (L.) Ktze. (*Amphicarpea monica*). Hog Peanut.
Glycine apios (L.) MacM. (*Apios tuberosa*). Ground Nut. No specimen.
Strophostyles helvola (L.) Britt. Trailing Wild-Bean.

Saxifragales.

Crassulaceae, Orpine Family.

- Sedum ternatum* Mx. Wild Stonecrop.
Penthorum sedoides L. Ditch Stonecrop.

Saxifragaceae, Saxifrage Family.

- Micranthes pennsylvanica* L. (Haw) (Saxifraga) Swamp Saxifrage. Near the pumping station N. E. of Sugar Grove. No specimen.
Micranthes virginiana (Mx.) Sm. Early Saxifrage.
Sullivantia sullivantii (T. & G.) Britt. Sullivantia. Abundant on dripping cliffs under waterfalls in the southern section of the area. Absent north of Cantwell Cliffs.

Tiarella cordifolia L. False Miterwort. Abundant and often the dominant under-herb of the deep forest in the southern section of the area, but never seen around Sugar Grove. It is incomprehensible to me how such an abundant plant can drop out so completely in so short a distance under conditions apparently so nearly uniform. No specimen.

Heuchera americana L. Alum-root.

Mitella diphylla L. Bishop's Cap.

Chrysosplenium americanum Schw. Golden Saxifrage.

Thymelaeas.

Lythraceae, Loosestrife Family.

Decodon verticillatus (L.) Ell. Water Willow. Only from Buckeye Lake.

Parsonsia petiolata (L.) Rusby. (*Cuphea viscosissima* Jacq.). Tar-weed.

Thymelaceae, Mezereum Family.

Dirca palustris L. Leatherwood. Cantwell Cliffs. No specimen.

Celastrales.

Rhamnaceae, Buckthorn Family.

Rhamnus lanceolata Pursh. Lanceleaf Buckthorn. Fide Bigelow.

Rhamnus caroliniana Walt. Carolina Buckthorn. A specimen was collected and determined in the field as *R. caroliniana* by the writer on Big Pine Creek June 20, 1911, but it was not preserved. The only specimen in state herbarium is from Adams Co.

Ceanothus americanus L. New Jersey Tea.

Vitaceae, Vine Family.

Vitis aestivalis Mx. Summer Grape.

Vitis bicolor LeConte. Blue Grape.

Vitis cordifolia Mx. Frost Grape. Fide Bigelow.

Parthenocissus quinquefolia (L.) Planch. (*Pseclera*). Virginia Creeper. No specimen.

Celastraceae, Staff-tree Family.

Euonymus obovatus Nutt. Running Strawberry-bush. No specimen.

Euonymus atropurpureus Jacq. Wahoo. Fide Bigelow.

Celastrus scandens L. Climbing Bitter-sweet.

Illicaceae, Holly Family.

Ilex verticillata (L.) Gr. Fever Bush.

Staphyleaceae, Bladdernut Family.

Staphylea trifolia L. American Bladdernut. No specimen.

Sapindales.

Aesculaceae, Buckeye Family.

Aesculus glabra Willd. Ohio Buckeye. No Specimen.

Aesculus octandra Marsh. Sweet Buckeye.

Aceraceae, Maple Family.

Acer spicatum Lam. Mountain Maple. Was reported by Bigelow. It is unknown to the writer.

Acer saccharinum L. Silver Maple. No specimen.

Acer rubrum L. Red Maple. Common on both uplands and lowlands.

Acer saccharum Marsh. Sugar Maple.

Acer nigrum Mx. Black Sugar Maple.

Acer negundo L. Box Elder.

Anacardiaceae, Sumac Family.

Rhus copallina L. Upland Sumac.

Rhus hirta (L.) Sudw. (*R. typhina*). Staghorn Sumac.

Rhus glabra L. Smooth Sumac.

Toxicodendron vernix (L.) Ktze. (*Rhus*) Poison Sumac. A single individual along the road near the center of section 4, Berne Twp., the extreme southern limit of the species. Reported by Bigelow without comment. Undoubtedly once far more plentiful than now.

Toxicodendron radicans (L.) Ktze. (*Rhus*) Poison Ivy. No specimen.

Subclass, AMENTIFERAE.

Platanales.**Hamamelidaceae**, Witch-hazel Family.

Hamamelis virginiana L. Witch-hazel.

Platanaceae, Planetree Family.

Platanus occidentalis L. Sycamore. On uplands as well as lowlands where the light is sufficiently intense.

Urticales.**Ulmaceae**, Elm Family.

Ulmus americana L. White Elm.

Ulmus fulva Mx. Slippery Elm.

Celtis occidentalis L. Hackberry.

Moraceae, Mulberry Family.

Morus rubra L. Red Mulberry.

Humulus lupulus L. Hop.

Cannabis sativa L. Hemp. Fide Bigelow.

Urticaceae, Nettle Family.

Urtica gracilis L. Slender Nettle. No specimen.

Urticastrum divaricatum (L.) Ktze. (*Laportea canadensis* (L.) Gaud.) Wood Nettle. Common. No specimen.

Pilea pumila (L.) Raf. (*Adicea*). Clear Weed. Common. No specimen.

Boehmeria cylindrica (L.) Sw. False Nettle. No specimen.

Parietaria pennsylvanica Muhl. Abundant. No specimen.

*Fagales.***Fagaceae**, Beech Family.

- Fagus grandifolia* Ehrh. American Beech.
Castanea dentata (Marsh.) Borkh. Chestnut.
Quercus alba L. White Oak.
Quercus stellata Wang. (*Q. minor*). Post Oak. Not common.
Quercus macrocarpa Mx. Bur Oak.
Quercus bicolor Willd. (*Q. platanoides*) Swamp White Oak.
Quercus prinus L. Rock Chestnut Oak.
Quercus imbricaria Mx. Shingle Oak.
Quercus velutina Lam. Black Oak.
Quercus coccinea Wang. Scarlet Oak.
Quercus rubra L. Red Oak.
Quercus palustris DuRoi. Pin Oak.

Betulaceae, Birch Family.

- Carpinus caroliniana* Walt. Blue Beech.
Ostrya virginiana (Mill.) Willd. Hop Hornbeam. Must occur at least on the western borders of the area but is not common and was not found after some little search by the writer.
Corylus americana Walt. Hazlenut. Common, no specimen.
Betula nigra L. Red Birch. Common on Queer Creek and some other streams in the southern portion of the area. Absent from the northern portion. Not known to the northward in Ohio.
Betula lenta L. Sweet Birch. Common throughout the area.
Betula lutea Mx. f. Yellow Birch. Common in the deep canyons of the southern half of the area, but altogether lacking in the northern section. Otherwise unknown south of Wayne and Summit Counties.
Alnus rugosa (DuRoi) Koch. Smooth Alder.

Juglandaceae, Walnut Family.

- Hicoria cordiformis* (Wang.) Britt. (*Carya*, *H. minima*) Bitternut.
Hicoria ovata (Mill.) Britt. (*Carya*) Shagbark (*Hicory*).
Hicoria laciniosa (Mx. f.) Sarg. (*Carya*) Not uncommon, no specimens.
Hicoria alba (L.) Britt. (*Carya*) Mockernut.
Hicoria microcarpa (Nutt.) Britt. (*Carya*) Small pignut.
Juglans nigra L. Black Walnut. Common along the Hocking Bottom; altogether lacking through most of the area.
Juglans cinerea L. Butternut. Common except on the richest land.

*Salicales.***Salicaceae**, Willow Family.

- Populus alba* L. Silver Poplar.
Populus balsamifera candicans (Ait.) Gr. Balm-of-Gilead.
Populus grandidentata Mx. Large-tooth Poplar.
Populus tremuloides Mx. American Aspen.
Populus deltoides Marsh. Cottonwood.

Salix nigra Marsh. Black Willow.

Salix fragilis L. Crack Willow.

Salix alba L. White Willow.

Salix alba vitellina (L.) Koch. Golden Osier.

Salix babylonica L. Weeping Willow. A single specimen along the river south of Sugar Grove, apparently not planted, now long dead. This species does not establish itself in Ohio.

Salix interior Rowlee (*S. fluviatilis*, *S. longifolia*). Sandbar Willow.

Salix discolor Muhl. Pussy Willow.

Salix discolor X *humilis*.

Salix humilis Marsh. Upland Willow.

Salix sericea Marsh. Silky Willow.

Salix cordata Muhl. Heart-leaf Willow.

Subclass MYRTIFLORAE.

Myrtales.

Hydrangeaceae, Hydrangea Family.

Hydrangea arborescens L. Wild Hydrangea.

Grossulariaceae, Gooseberry Family.

Grossularia cynosbati (L.) Mill. Wild Gooseberry.

Ribes odoratum Wendl. Golden Currant.

Onagraceae, Evening Primrose Family.

Isuardia pulustris L. (*Ludwigia*) Marsh Purslane. No specimen.

Ludwigia polycarpa, Short & Peter. Many fruited *Ludwigia*. No specimen.

Ludwigia alternifolia L. Seedbox.

Epilobium coloratum Muhl. Purple Willow-herb.

Oenothera biennis (L.) Scop. Evening Primrose.

Kneiffia pumila (L.) Spach. (*Oenothera*). Small Sundrops.

Gaura biennis L. No specimen.

Circaea lutetiana L. Common enchanter's Nightshade.

Circaea alpina L. Small enchanter's Nightshade. Common in the caves of the southern section, not found around Sugar Grove. On the edge of its range.

Haloragidaceae, Water Milfoil Family.

Myriophyllum spicatum L. Spiked Water-milfoil. From Buckeye Lake.

Loascales.

Cucurbitaceae, Pumpkin Family.

Micrampelis lobata (Mx.) Greene. Wild Cucumber.

Sicyos angulatus L. Star Cucumber.

Aristolochiales.

Aristolochiaceae, Birthwort Family.

Asarum canadense L. Wild-ginger.

Asarum reflexum Bicknell. Short-lobed Wild-ginger.

Aristolochia serpentaria L. Virginia Snakeroot.

*Santalales.***Santalaceae**, Sandalwood Family.

Comandra umbellata (L.) Nutt. Bastard Toad-flax.

Subclass HETEROMERAE.

*Primulales.***Primulaceae**, Primrose Family.

Samolus floribundus H. B. K. Water Pimpernel.

Lysimachia quadrifolia L. Whorled Loosestrife.

Lysimachia terrestris (L.) B. S. P. Fide Bigelow.

Lysimachia nummularia L. Moneywort. No specimen.

Steironema ciliatum (L.) Raf. Fringed yellow Loosestrife.

Steironema lanceolatum (Walt) Gr. Fide Bigelow.

Steironema quadriflorum (Sims) Hitch.

Naumbergia thyrsiflora (L.) Duby. Fide Bigelow.

Anagalis arvensis L. Scarlet Pimpernel.

Dodecatheon meadia L. Shooting Star. Several patches found on the cliffs on the west side of "The Gulf." Also reported by Bigelow for Fairfield Co.

*Ericales.***Pyrolaceae**, Wintergreen Family.

Pyrola americana Sw. Round-leaf Wintergreen. Scarce.

Pyrola elliptica Nutt. Shinleaf Wintergreen. The common form.

Chimaphila maculata (L.) Pursh. Spotted Pipsisewa.

Monotropaceae, Indian-pipe Family.

Monotropa uniflora L. Indian-pipe.

Hypopitys americana (D. C.) Small Pinesap.

Ericaceae, Heath Family.

Azalea lutea L. (*Rhododendron calendulaceum*) Flame Azalea. Common on a few hillsides in the immediate vicinity of Sugar Grove. The only station in the state. Persistent and long continued search for it in the southern section of the area during its flowering season has failed to reveal it. It is in imminent danger of extinction and should be protected.

Rhododendron maximum L. Rhododendron. Abundant in the northern section of the area from Clark's Crossing to Sugar Grove and a little beyond. Also at the "Written Rock" on Clear Creek and near the head of Laurel Run. Otherwise absent from the southern section although there are multitudes of habitats apparently more suitable for it than those in which it has been found.

Kalmia angustifolia L. Sheep Laurel. I have been informed by trustworthy observers that this plant formerly grew in the area and have been directed to one of its habitats, namely the head of Laurel Run, but I have not found it. Neither was it known to Bigelow or Sullivant, nor is there an authentic specimen from Ohio.

Oxydendrum arboreum (L.) DC. Sorrel-tree. On the edge of its range. Common.

Epigaea repens L. Trailing arbutus. Common.

Gaultheria procumbens L. Creeping Wintergreen.

Vacciniaceae, Huckleberry Family.

Gaylussacia baccata (Wang.) Koch. (G. resinosa) Huckleberry.

Polycodium stamineum (L.) Greene. Deerberry.

Vaccinium angustifolium Ait. Dwarf Blueberry.

Vaccinium vacillans Kalm. Low Blueberry.

Oxycoccus macrocarpus (Ait.) Pers. (*Vaccinium*) Cranberry. Fide Bigelow, doubtless only in Buckeye Lake.

*Ebenales.***Ebenaceae**, Ebony Family.

Diospyros virginiana L. Persimmon. Abundant but does not fruit freely.

Subclass TUBIFLORAE.

*Polemoniales.***Polemoniaceae**, Phlox Family.

Phlox paniculata L. Garden Phlox.

Phlox maculata L. Spotted Phlox.

Phlox divaricata L. Wild Sweet-william.

Phlox stolonifera Sims. (*P. reptans*) Creeping Phlox. Not uncommon in the deepest ravines of the southern section of the area. The only Ohio stations.

Phlox subulata L. Ground Phlox.

Polemonium reptans L. Greek Valerian. No specimen.

Convolvulaceae, Morning-glory Family.

Ipomoea pandurata (L.) Meyer. Wild Potato-vine.

Ipomoea purpurea (L.) Roth. Common Morning-glory. No specimen.

Convolvulus sepium L. Hedge Bindweed.

Cuscutaceae, Dodder Family.

Cuscuta coryli Englem. Hazel Dodder.

Cuscuta gronovii Willd. Gronovius's Dodder.

Hydrophyllaceae, Water-leaf Family.

Hydrophyllum virginianum L. Virginia Water-leaf. Fide Bigelow.

Hydrophyllum macrophyllum Nutt. Large-leaf Water-leaf.

Hydrophyllum appendiculatum Mx. Appendaged Water-leaf. No specimen.

Hydrophyllum canadense L. Broad-leaf Water-leaf. No specimen.

Phacelia dubia (L.) Small. Small-flowered Phacelia. On the ridge west of Clark's Crossing and a few other localities, the only Ohio stations.

Phacelia purshii Buckl. Pursh's Phacelia. In the Hocking Bottom at Sugar Grove. No specimen.

*Gentianales.***Oleaceae**, Olive Family.

[*Fraxinus quadrangulata* Mx.] Blue Ash. Apparently reaches the eastern edge of its range just west of the present area. It is common about Columbus, but has not been seen around Sugar Grove.

Fraxinus pennsylvanica Marsh. Red Ash.

Fraxinus lanceolata Borek. Green Ash.

Fraxinus americana L. White Ash.

Gentianaceae, Gentian Family.

Sabbatia angularis (L.) Pursh. Square Stemmed Sabbattia.

Gentiana erinita Froel. Fringed Gentian. Fide Bigelow.

Gentiana quinquefolia L. Stiff Gentian. Fide Bigelow.

Gentiana saponaria L. (*Dasystephana*) Soapwort Gentian. Fide Bigelow.

Gentiana andrewsii Griseb. Closed Gentian.

Frasera carolinensis Walt. American Columbo. Fide Bigelow.

Oblaria virginica L. Pennywort.

Apocynaceae, Dogbane Family.

Apocynum androsaemifolium L. Spreading Dogbane.

Apocynum cannabinum L. Indian Hemp.

Asclepiadaceae, Milkweed Family.

Asclepias tuberosa L. Butterfly weed. Occasional. No specimen.

Asclepias purpurascens L. Purple Milkweed. Fide Bigelow.

Asclepias incarnata L. Swamp Milkweed.

Asclepias sullivantii Engelm. Rare. Known otherwise only from Erie Co.

Asclepias amplexicaulis Sm. Blunt leaved Milkweed. Rare. Collected on the ridge west of Clark's Crossing. Known otherwise only from Erie County.

Asclepias exaltata (L.) Muhl. (*A. phytoleucoides*) Tall Milkweed.

Asclepias variegata L. White Milkweed. Collected once on Big Pine Creek by B. W. Wells and the writer. Known otherwise in Ohio only from Summit Co.

Also reported by Bigelow for Fairfield Co.

Asclepias quadrifolia L. Four-leafed Milkweed.

Asclepias syriaca L. Common Milkweed.

Asclepias verticillata L. Whorled Milkweed. Kettle Hills, W. A. Kellerman. Rare.

Scrophulariales.

Solanaceae, Potato Family.

Datura stramonium L. Jimson-weed. No specimen.

Physalis pubescens L. Low hairy Ground-cherry. No specimen.

Physalis lanceolata Mx.

Physalis virginiana Mill. Fide Bigelow.

Physalis heterophylla Nees.

Lycopersicon lycopersicon (L.) Karst. (*L. esculentum*) Tomato.

Solanum tuberosum L. Potato.

Solanum nigrum L. Black Nightshade.

Solanum carolinense L. Horse nettle. Bigelow cites this now troublesome weed as collected exclusively by A. Hor of Baltimore, Ohio. Apparently it had just appeared in 1841. No specimen.

Scrophulariaceae, Figwort Family.

Verbascum thapsus L. Common Mullein.

Verbascum blattaria L. Moth Mullein.

- Linaria linaria* (L.) Karst. (*L. vulgaris*) Butter and Eggs.
Scrophularia marylandica L. Maryland Figwort. No specimen.
Chelone glabra L. Turtle-head.
Penstemon hirsutus (L.) Willd. Hairy Beard-tongue. No specimen.
Penstemon penstemon (L.) Britt. (*P. leavigatus*) Smooth Beard-tongue. No specimen.
Collinsia verna Nutt. Blue-eyed Mary. Fide Bigelow.
Mimulus ringens L. Square-stemmed Monkey Flower.
Mimulus alatus Soland. Winged Monkey-flower.
Gratiola virginica L. Clammy Hedge-hyssop.
Ilysanthes dubia (L.) Barnh. Long Stalked False Pimpernel.
Veronica anagalis-aquatica L. Water Speedwell. Fide Bigelow.
Veronica scutellata L. Skullcap Speedwell. Fide Bigelow.
Veronica officinalis L. Common Speedwell.
Veronica serpyllifolia L. Thyme-leaf Speedwell. Fide Bigelow.
Veronica peregrina L. Purslane Speedwell.
Veronica arvensis L. Field Speedwell.
Leptandra virginica (L.) Nutt. (*Veronica*) Culver's Root.
Azelia macrophylla (Nutt.) Ktze. (*Seymeria*) Mullein Foxglove. Written Rock, Clear Creek, W. A. Kellerman. Not seen within the area by the writer, but a few plants were found in Vinton County about a mile below the Queer Creek Divide. On the edge of its range.
Dasytoma flava (L.) Wood (*Gerardia*) Downy False Foxglove.
Dasytoma laevigata Raf. (*Gerardia*) Entire-leaf False Foxglove.
Dasytoma virginica (L.) Britt. Smooth False Foxglove. These are all on the edges of their ranges but unlike *Azelia* they are common.
Agalinus tenuifolia (Vahl) Raf. Slender *Gerardia*.
Agalinus purpurea (L.) Britt. Large Purple *Gerardia*. Lancaster, J. E. Hyde.
Otophylla auriculata Mx. Auricled *Gerardia*. Fide Bigelow. Now known only from Ottawa Co.
Buchnera americana L. Blue Hearts. Fide Bigelow. Now known only from Fulton County.
Castilleja coccinea (L.) Spreng. Painted Cup. Fide Bigelow. Now known only from Franklin and Knox counties.
Pedicularis lanceolata Mx. Lanceleaf Lousewort. In the swamp along the Logan Pike a mile south of Rockbridge, the southernmost station known in this part of the state.
Pedicularis canadensis L. Wood Lousewort.
Melampyrum lineare Lam. Cow-wheat. Abundant in the edge of the woods above the canyon of Queer Creek just east of "The Gulf." The only station known south of Portage County.

Orobanchaceae, Broom-rape Family.

- Conopholis americana* (L. f.) Wallr. Squaw-root.
Leptamium virginicum (L.) Raf. (*Epiphagus*) Beech-drops.

Bignoniaceae, Bignonia Family.

- Catalpa speciosa* Warder. Hardy Catalpa.

Martyniaceae, Unicorn-plant Family.

Martynia louisiana Mill. Unicorn Plant. Reported by Bigelow as collected at Baltimore by Dr. Hor. Whether as wild or as an escape is not stated. Now known from Richland, Ross, and Lorain counties. If it was wild its natural range is greater than is credited in the manuals, which give it as "S. Ind., Ill., and Ia. to N. Mex. Also cultivated and naturalized northw."

Lentibulaceae, Bladderwort Family.

Utricularia macrophylla LeC. (*U. vulgaris*) Greater Bladderwort. Ponds along the old canal. No specimen.

Utricularia gibba L. Humped Bladderwort. Buckeye Lake only.

Acanthaceae, Acanthus Family.

Ruellia strepens L. Smooth Ruellia. No specimen, observed at Clark's Crossing.

Dianthera americana L. Water-willow. Common. No specimen.

*Lamiales.***Boraginaceae**, Borage Family.

Cynoglossum officinale L. Hound's Tongue. No specimen.

Cynoglossum virginicum L. Wild Comfrey. Occasional.

Lappula lappula (L.) Karst. (*L. echinata*). European Stickseed. Spread throughout the lowland forest. No specimen.

Lappula virginiana (L.) Greene. Virginia Stickseed.

Mertensia virginica (L.) DC. Virginia cowslip. No specimen.

Myosotis arvensis (L.) Lam. Field Forget-me-not. Fide Bigelow.

Myosotis virginica (L.) B. S. P. Virginia Forget-me-not.

Lithospermum arvense L. Corn Gromwell. No specimen.

Lithospermum officinale L. Common Gromwell. Fide Bigelow. No Ohio specimens are known.

Lithospermum canescens (Mx.) Lehm. Hoary Puccoon. Fide Bigelow. Certainly very uncommon.

Onosmodium carolinianum (L.) D. C. Shaggy False Gromwell. Fide Bigelow.

Symphytum officinale L. Common Comfrey. Fide Bigelow.

Verbenaceae, Vervain Family.

Verbena urticifolia L. White Vervain. No specimen.

Verbena hastata L. Blue Vervain. No specimen.

Lippia lanceolata Mx. Frog-fruit. Bigelow reports this species as seen only by Dr. Hor of Baltimore. It is common enough now.

Lamiaceae, Mint Family.

Teucrium canadense L. American Germander. No specimen.

Isanthus brachiatus (L.) B. S. P. False Pennyroyal.

Trichostema dichotomum L. Blue Curls.

Scutellaria lateriflora L. Mad-dog Skullcap.

Scutellaria incana Muhl. Downy Skullcap.

Scutellaria cordifolia Muhl. (*S. versicolor*) Heart-leaf Skullcap. No specimen, common.

- Scutellaria pilosa* Mx. Hairy Skullcap. Collected and determined in the field by the writer on June 21, 1911. Big Pine Creek. No specimen saved. Later it was found there are no specimens in the state herbarium.
- Scutellaria parvula* Mx. Small Skullcap. Fide Bigelow.
- Scutellaria galericulata* L. Marsh Skullcap. Fide Bigelow.
- Agastache nepetoides* (L.) Ktze. Giant Hyslop.
- Agastache scrophulariaefolius* (Willd.) Ktze.
- Nepeta cataria* L. Catnip. No specimen.
- Glechoma hederacea* L. (Nepeta) Ground Ivy. No specimen.
- Prunella vulgaris* L. Self Heal.
- Dracocephalum virginiana* L. Physostegia. False Dragon Head.
- Leonurus cardiaca* L. Motherwort. Abundant. No specimen.
- Lamium amplexicaule* L. Henbit. No specimen.
- Stachys tenuifolia* Willd. Smooth Hedge Nettle.
- Stachys asper* Mx. Rough Hedge Nettle.
- Monarda clinopodia* L. Basal Balm.
- Monarda fistulosa* L. Wild Bergamot.
- Blephilia hirsuta* (Pursh) Torr.
- Hedeoma pulegeoides* (L.) Pers. American Pennyroyal. Abundant. No specimen.
- Melissa officinalis* L. Lemon Balm.
- Origanum vulgare* L. Wild Marjoram.
- Koellia flexuosa* (Walt) MacM. (Pycnanthemum). Narrow-leaf Mountain-mint.
- Koellia pilosa* (Nutt.) Britt. (Pycnanthemum). Hairy Mountain-mint.
- Koellia incana* (L.) Ktze. (Pycnanthemum). Hoary Mountain-mint.
- Koellia mutica* (L.) Britt. (Pycnanthemum). Short-toothed Mountain-mint. Fide Bigelow.
- Cunilla originoides* (L.) Britt. American Ditany.
- Lycopus virginicus* L. Bungle-weed.
- Lycopus rubellus* Moench. Stalked Water-horhound.
- Lycopus americanus* Muhl. (L. lucidus var.). Cut-leaf Water-horhound.
- Mentha spicata* L. Spearmint.
- Mentha piperita* L. Peppermint.
- Mentha canadensis* L. American Wild Mint.
- Collinsonia canadensis* L. Stone Root.

Phrymaceae, Lopseed Family.

- Phyrma leptostachya* L. Lopseed. Often the dominant herb in the forest. No specimen.

Plantaginales.

Plantaginaceae, Plantain Family.

- Plantago rugellii* Dec. Broad-leaf Plantain.
- Plantago major* L. Broad-leaf Plantain. Fide Bigelow.
- Plantago lanceolata* L. Rib-grass Plantain.
- Plantago cordata* Lam. Water Plantain. Fide Bigelow.
- Plantago aristata* Mx. Large Bracted Plantain. No specimen.
- Plantago virginica* L. Dwarf Plantain. Common. No specimen.

Subclass, INFERRAE.

*Umbellales.***Araliaceae**, Ginseng Family.

- Aralia spinosa* L. Angelica-tree. Common on Queer Creek; scarce on Big Pine Creek; absent north of that point, but undoubtedly gradually extending its range to the northward. Otherwise known as a wild plant only in Clermont Co.
- Aralia racemosa* L. American Spikenard.
- Aralia nudicaulis* L. Wild Sarsaparilla. No specimen.
- Panax quinquefolium* L. Ginseng. Formerly abundant, but now practically exterminated. The state herbarium has a specimen collected at Lancaster by Earl Hyde, but the writer has not been fortunate enough to see it growing.

Amiaceae, Carrot Family.

- Eryngium aquaticum* L. (*E. yuccaeifolium* of Gr. Man., ed. 7). Rattlesnake Master. Fide Bigelow.
- Sanicula canadensis* L. Short-styled Snake Root.
- Washingtonia claytoni* (Mx.) Britt. (*Osmorrhiza brevistylis*). Woolly Sweet-cicely. No specimen.
- Washingtonia longistylis* (Torr.) Britt. (*Osmorrhiza*). Long-styled Sweet-cicely. No specimen.
- Erigenia bulbosa* (Mx.) Nutt. Harbinger of Spring. No specimen.
- Conium maculatum* L. Poison Hemlock. Fide Bigelow.
- Zizia aurea* (L.) Koch. Early Meadow Parsnip. Fide Bigelow.
- Cicuta maculata* L. Water Hemlock.
- Deeringia canadensis* (L.) Ktze. Honewort. Fide Bigelow.
- Sium cicutaefolium* L. Water Parsnip. Fide Bigelow.
- Foeniculum foeniculum* (L.) Karst. (*F. vulgare*). Fennel.
- Thaspium barbinode* (Mx.) Nutt. Hairy-jointed Meadow-parsnip. Fide Bigelow.
- Thaspium trifoliatum* (L.) Britt. Fide Bigelow.
- Angelica atropurpurea* L. Purple-stemmed Angelica.
- Angelica villosa* (Walt.) B. S. P.
- Oxypolis rigidus* (L.) Conlt & Rose. Cowbane. Fide Bigelow.
- Pastinaca sativa* L. Wild Parsnip. Fide Bigelow.
- Heracleum lanatum* Mx. Cow Parsnip. Fide Bigelow.
- Daucus carota* L. Wild Carrot.

Cornaceae, Dogwood Family.

- Cornus alternifolia* Lf. Alternate-leaf Cornel.
- Cornus stolonifera* Mx. Red Osier Dogwood. Fide Bigelow.
- Cornus femina* Mill. (*C. candidissima*, *C. paniculata*). Panoled Cornel.
- Cornus amomum* Mill. Silky Dogwood.
- Cynoxylon floridum* (L.) Raf. (*Cornus*). Flowering Dogwood.
- Nyssa sylvatica* Marsh. Tupelo.

*Rubiales.***Rubiaceae**, Madder Family.

- Houstonia coerulua* L. Bluets.
- Houstonia longifolia* Gaertn. Long-leaf Houstonia.

Cephalanthus occidentalis L. Button-bush.
Mitchella repens L. Partridge Berry.
Galium aparine L. Common Cleavers. Fide Bigelow.
Galium pilosum Ait. Hairy Bedstraw.
Galium lanceolatum Torr. Lance-leaf Wild Licorice.
Galium circaeazans Mx. Wild Licorice. Fide Bigelow.
Galium triflorum Mx. Fragrant Bedstraw.
Galium tinctorium L. Stiff Marsh Bedstraw. Fide Bigelow.
Galium concinnum T. & G. Shining Bedstraw.
Galium asperellum Mx. Rough Bedstraw. Fide Bigelow.

Caprifoliaceae, Honeysuckle Family.

Sambucus canadensis L. Common Elderberry.
Sambucus racemosa L. (*S. pubens*). Red Elderberry. Common in the caves of the southern section of the area; rare or absent in the northern section.
Viburnum acerifolium L. Maple-leaf Arrow-wood.
Viburnum molle Mx. Soft-leaf Arrow-wood.
Viburnum cassinoides L. Withe-rod.
Viburnum lentago L. Sheepberry. Fide Bigelow.
Viburnum prunifolium L. Black Haw.
Triosteum perfoliatum L. Horse Gentian. No specimen.
Lonicera hirsuta Eaton. Hairy Honeysuckle. Fide Bigelow.
Lonicera tartarica L. Tartarian Honeysuckle. Escaped near Sugar Grove. No specimen.

Valerianaceae, Valerian Family.

Valeriana pauciflora Mx. Large-flowered Valerian. No specimen. Observed in "The Gulf."

Campanulales.

Campanulaceae, Bellflower Family.

Campanula aparinoides Pursh. Marsh Bellflower. Fide Bigelow.
Campanula americana L. Tall Bellflower.
Specularia perfoliata (L.) D. C. (*Legouzia*). Venus's Looking Glass.

Lobeliaceae, Lobelia Family.

Lobelia cardinalis L. Cardinal Flower.
Lobelia syphyllitica L. Blue Lobelia.
Lobelia puberula Mx. Downy Lobelia. Abundant along the Queer Creek Road below the canyon. Seen nowhere else; its most northern station in Ohio. Otherwise known only from Gallia and Meigs counties.
Lobelia spicata Lam. Pale Spiked Lobelia.
Lobelia leptostachys A. D. C. Spiked Lobelia.
Lobelia inflata L. Indian Tobacco.
Lobelia kalmii L. Kalm's Lobelia. Fide Bigelow.

Compositales.

Dipsacaceae, Teasel Family.

Dipsacus sylvestris Mill. Wild Teasel. No specimen.

Ambrosiaceae, Ragweed Family.

Ambrosia trifida L. Horseweed.

Ambrosia elatior L. (*A. artemisiaefolia*). Ragweed.

Xanthium pennsylvanicum Wallr. (*X. canadense* auth.). American Cocklebur.

Helianthaceae, Sunflower Family.

Heliopsis helianthoides (L.) B. S. P. Smooth Ox-eye.

Verbesina alba (L.) Eclipta.

Rudbeckia hirta L. Black-eyed Susan.

Rudbeckia fulgida Ait. Orange Cone-flower. Fide Bigelow.

Rudbeckia laciniata L. Tall Cone-flower. Common. No specimen.

Echinacea purpurea (L.) Moench. (*Brauneria*). Purple Cone-flower. Fide Bigelow.

Helianthus microcephalus T. & G. Small Wood Sunflower.

Helianthus giganteus L. Giant Sunflower.

Helianthus hirsutus Raf. Stiff-haired Sunflower.

Helianthus tuberosus L. Jerusalem Artichoke.

Ridic alternifolia (L.) Britt. (*Verbesina*). Actinomeris. No specimen.

Coreopsis tripteris L. Tall Tickseed.

Bidens laevis (L.) B. S. P. Smooth Burr-Marigold. Fide Bigelow.

Bidens cernua L. Nodding Burr-Marigold. No specimen.

Bidens connata Muhl. Swamp Burr-Marigold. No specimen.

Bidens frondosa L. Black Beggar-ticks. No specimen.

Bidens bipinnata L. Spanish Needles. No specimen.

Bidens trichosperma (Mx.) Britt. Tall Tickseed.

Bidens aristosa (Mx.) Britt. Western Tickseed. On the edge of its range; reported only from counties west of the present area. No specimen.

Galinsoga parviflora hispida D. C. (*G. caracasana*). In Mr. Stukey's barnyard and other places. No specimen.

Polymnia canadensis L. Small-flowered Leafcup. Fide Bigelow.

Silphium perfoliatum L. Indian Cup.

Silphium trifoliatum L. Whorled Rosin Weed.

Helenium autumnale L. Common Sneezeweed. No specimen.

Inula helenium L. Elecampane.

Gnaphalium obtusifolium L. Fragrant Cudweed.

Gnaphalium uliginosum L. Marsh Cudweed.

Antennaria neglecta Greene. (det. Fernald). Field Everlasting. Upland fields.

Antennaria fallax Greene. (det. Fernald). Tall Everlasting. Woods.

Antennaria plantaginifolia (L.) Rich. (det. Fernald). Plantain-leaf Everlasting.

Antennaria parlinii Fernald (det. Fernald). Parlin's Everlasting.

Chrysopsis mariana (L.) Nutt. Maryland Golden Aster. Common in some places in the southern section of the area; known otherwise only from Jackson County.

Solidago caesia L. Wreath Goldenrod.

Solidago flexicaulis L. (*S. latifolia*). Zigzag Goldenrod.

Solidago bicolor L. White Goldenrod.

Solidago erecta Pursh. Slender Goldenrod. Known only from Fairfield, Hocking, and Meigs counties.

Solidago speciosa Nutt. Showy Goldenrod.

- Solidago rugosa* Mill. Wrinkled-leaf Goldenrod.
Solidago patula Muhl. Rough-leaf Goldenrod.
Solidago ulmifolia Muhl. Elm-leaf Goldenrod.
Solidago neglecta T. & G. Swamp Goldenrod.
Solidago juncea Ait. Plume Goldenrod.
Solidago canadensis L. Canada Goldenrod.
Solidago nemoralis Ait. Gray Goldenrod.
Solidago rigida L. Stiff Goldenrod. Fide Bigelow.
Euthamia graminifolia (L.) Nutt. (*Solidago*). Bushy Fragrant Goldenrod. Fide Bigelow.
Boltonia asteroides (L.) L'Her. Boltonia. Fide Bigelow.
Sericocarpus asteroides (L.) B. S. P. White-top Aster.
Aster divaricatus L. White Wood Aster. Common.
Aster macrophyllus L. Large-leaf Aster.
Aster shortii Hook. Short's Aster.
Aster cordifolius L. Common Blue Wood Aster. Common. No specimen.
Aster lowrieanus Port. Lowrie's Aster.
Aster sagittifolius Willd. Arrow-leaf Aster.
Aster novae-angliae L. New England Aster. No specimen.
Aster puniceus L. Purple Stemmed Aster.
Aster ericoides L. White Heath Aster.
Aster lateriflorus (L.) Britt. Starved Aster.
Erigeron puchellus Mx. Showy Fleabane.
Erigeron philadelphicus L. Philadelphia Fleabane. No specimen. Common.
Erigeron annuus (L.) Pers. White-top Fleabane.
Erigeron ramosus (Walt.) B. S. P. Daisy Fleabane. Common. No specimen.
Leptilon canadense (L.) Britt. (*Erigeron*). Horseweed. No specimen.
Doellingeria umbellata (Mill) Nees. (*Aster*). Tall White-top Aster.
D. humilis, which is reduced to a var. by Gray, is also reported by Bigelow, but is not otherwise known in Ohio.
Ionactis linearifolius (L.) Greene. (*Aster*). Stiff-leaf Aster. Isolated plants are not rare in the southern section of the area, but one may walk all day without seeing one even when in blossom. Otherwise known only from Adams County.
Eupatorium purpureum L. Joe-Pye-weed. Common. No specimen.
Eupatorium rotundifolium L. Round-leaf Thoroughwort. Common in the southern section, the only known Ohio station.
Eupatorium sessilifolium L. Upland Boneset.
Eupatorium perfoliatum L. Common Boneset.
Eupatorium ageratoides L. f. White Snake-root.
Eupatorium aromaticum L. Smaller White Snake-root. Common in the southern section of the area as far north as the town of Rockbridge. Reported also by Bigelow, but not otherwise known in Ohio.
Eupatorium coelastinum L. Mist-flower.
Laciniaria scariosa (L.) Mill. (*Liatris*). Large Blazing-star. A single specimen in the pine thicket directly west of Crystal Springs. Known elsewhere only from Erie and Lucas counties.

- Lacinaria spicata* (L.) Willd. (*Liatris*). Dense Blazing-star. Pine Barren, above Old Man's Cave, a single stalk, B. W. Wells. Also reported by Bigelow for Fairfield County.
- Vernonia altissima* Nutt. (*V. gigantea*, *V. maxima*). Tall Ironweed. Abundant. No specimen.
- Achillea millefolium* L. Common Milfoil. Abundant. No specimen.
- Anthemis cotula* L. Common Dog Fennel.
- Chrysanthemum leucanthemum* L. Ox-eye Daisy.
- Tanacetum vulgare* L. Common Tansy. No specimen.
- Erechtites hieracifolia* (L.) Raf. Fireweed. Abundant. No specimen.
- Mesadenia atriplicifolia* (L.) Raf. (*Cacalia*). Pale Indian Plantain.
- Senecio aureus* L. Golden Groundsel. Common and conspicuous in the spring. No specimen.
- Arctium minus* Schk. Common Burdock. No specimen.
- Cirsium lanceolatum* (L.) Hill. (*Carduus*). Spear Thistle. No specimen.
- Cirsium altissimum* (L.) Spreng. Tall Thistle. No specimen.
- Cirsium discolor* (Muhl). Spreng. Field Thistle.
- Cirsium virginianum* (L.) Mx. Virginia Thistle. Fide Bigelow. Now known only from Madison County.

Cicoriaceae, Chicory Family.

- Cynthia virginicum* (L.) Ktze. (*Kregia amplexicaulis*, *Adopogon*). Virginia Dwarf-dandelion.
- Leontodon taraxacum* L. (*T. officinale*). Dandelion.
- Sonchus oleraceus* L. Common Sow-thistle. No specimen.
- Sonchus aspera* (L.) Hill. Spiny Sow-thistle. No specimen.
- Lactuca virosa* L. Strong-scented Lettuce.
- Lactuca canadensis* L. Tall Lettuce.
- Lactuca spicata* (Lam) Hitch. Tall Blue Lettuce. Fide Bigelow.
- Lactuca integrifolia* Bigel. Entire-leaf Lettuce. The only Ohio station.
- Hieracium venosum* L. Veined Hawkweed.
- Hieracium paniculatum* L. Panicle Hawkweed.
- Hieracium scabrum* Mx. Rough Hawkweed.
- Hieracium marianum* Willd. Maryland Hawkweed. I have worked over the last three in the Gray Herbarium and submitted them to Professor Fernald, but it is not possible to make very satisfactory determinations. The characters given in the manuals seem worthless for diagnosis. I give the names merely for what they are worth.
- Nabalus altissimus* (L.) Hook. (*Prenanthes*). Tall Rattlesnake-root.
- Nabalus albus* (L.) Hook. (*Prenanthes*). White Rattlesnake-root. Fide Bigelow.
- Nabalus racemosus* (Mx.) D. C. (*Prenanthes*). Glaucous Rattlesnake-root. Fide Bigelow.
- Nabalus crepidinens* (Mx.) D. C. (*Prenanthes*). Corymbed Rattlesnake-root. Fide Bigelow.

Synopsis-Summary of the Sugar Grove Flora

Phylum Ptenophyta		Liliflorae (total 59)	
Class, Felices		Liliales (p. 312)	
Subclass, Eusporangiatae		Liliaceae	21
Order, Ophioglossales (p. 306)		Smilacaceae	5
Family, Ophioglossaceae	4	Pontederiaceae	1
Leptosporangiatae		Commelinaceae	1
Felicales (p. 306)		Juncaceae	5
Osmundaceae	3	Xyridaceae	1
Polypodiaceae	26	Iridales (p. 314)	
Calamophyta		Amyrilidaceae	1
Equisetae		Dioscoreaceae	1
Equisetales, Equisetaceae (p. 307)....	3	Iridaceae	3
Lepidophyta		Orchidales, Orchidaceae (p. 314)...	20
Lycopodiae		Total Monocotylae	221
Lycopodiales, Lycopodiaceae (p. 307)	5		
Selaginelleae		Dicotylae	
Selaginellales, Selaginellaceae (p. 307)	1	Thalamiflorae (total 118)	
Total Pteridophytes	42	Fanales (p. 315)	
Strobilophyta		Magnoliaceae	2
Coniferae		Annonaceae	1
Pinales (p. 308)		Ranunculaceae	26
Pinaceae	3	Parnassiaceae	1
Juniperaceae	1	Ceratophyllaceae	1
Taxales, Taxaceae (p. 308).....	1	Berberidaceae	3
Total Gymnosperms	5	Menispermaceae	1
Anthophyta		Lauraceae	2
Monocotyleae		Brassicales (p. 316)	
Helobiae (total 6)		Papaveraceae	2
Alismales (p. 308)		Fumariaceae	3
Alismaceae	2	Brassicaceae	22
Scheucheriaceae	1	Geraniales (p. 317)	
Potamogetonaceae	1	Geraniaceae	2
Nymphaeales, Nymphaeaceae (p.308)	2	Oxalidaceae	4
Spadiciflorae (total 11)		Limnanthaceae	1
Pandanales (p. 308)		Linaceae	1
Sparganiaceae	2	Balsamaceae	2
Typhaceae	1	Rutaceae	1
Arales (p. 309)		Simarubaceae	1
Araceae	4	Polygalaceae	5
Lemnaceae	4	Euphorbiaceae	7
Glumiflorae (total 145)		Callitrichaceae	1
Graminales (p. 309)		Malvales (p. 318)	
Cyperaceae	67	Malvaceae	5
Graminaceae	78	Tiliaceae	1
		Guttiferales (p. 318)	
		Hypericaceae	7
		Cistaceae	3
		Violaceae	13
		Passifloraceae	1

Centrospermae (total 49)		Heteromerae (total 26)	
Caryophyllales (p. 319)		Primulales, Primulaceae (p. 328)..	
Caryophyllaceae	16	Ericales (p. 328)	
Aizoaceae	1	Pyrolaceae	
Portulacaceae	2	Monotropaceae	
Phytolaccaceae	1	Ericaceae	
Chenopodiales (p. 320)		Vacciniaceae	
Corrigiolaceae	1	Ebenales, Ebenaceae (p. 329).....	
Amaranthaceae	2	Tubiflorae (total 146)	
Chenopodiaceae	4	Polemoniales (p. 329)	
Polygonales, Polygonaceae (p. 320)		Polemoniaceae	
Piperales, Saururaceae (p. 321)....	1	Convolvulaceae	
Calyciflorae (total 123)		Cuscutaceae	
Rosales (p. 321)		Hydrophyllaceae	
Rosaceae	43	Gentianales (p. 329)	
Fabaceae	43	Oleaceae	
Saxifragales (p. 323)		Gentianaceae	
Crassulaceae	2	Apocynaceae	
Saxifragaceae	7	Asclepiadaceae	
Thymelales (p. 324)		Serophulariales (p. 330)	
Lythraceae	2	Solanaceae	
Thymelaceae	1	Serophulariaceae	
Celastrales (p. 324)		Orobanchaceae	
Rhamnaceae	3	Bignoniaceae	
Vitaceae	4	Martyniaceae	
Celastraceae	3	Lentibulaceae	
Ilicaceae	1	Acanthaceae	
Staphyleaceae	1	Lamiales (p. 332)	
Sapindales (p. 324)		Boraginaceae	
Aesculaceae	2	Verbenaceae	
Aceraceae	6	Lamiaceae	
Anacardiaceae	5	Phrymaceae	
Amentiferae (total 55)		Plantaginales, Plantaginaceae (p. 333)	
Platanales (p. 325)		Inferae (total 168)	
Hamelidaceae	1	Umbellales (p. 334)	
Platanaceae	1	Araliaceae	
Urticales (p. 325)		Amiaceae	
Ulmaceae	3	Cornaceae	
Moraceae	3	Rubiales (p. 334)	
Urticaceae	5	Rubiaceae	
Fagales (p. 326)		Caprifoliaceae	
Fagaceae	12	Valerianaceae	
Betulaceae	7	Campanulales (p. 335)	
Juglandaceae	7	Campanulaceae	
Salicales, Salicaceae (p. 326).....		Lobeliaceae	
Myrtiflorae (total 19)		Compositales (p. 335)	
Myrtales (p. 327)		Dipsacaceae	
Hydrangeaceae	1	Ambrosiaceae	
Grossulariaceae	2	Helianthaceae	
Onagraceae	9	Cichoriaceae	
Haloragidaceae	1	Total Dicotylae	
Loasales, Cueurbitaceae (p. 327)...		Grand total	
Aristolochiales, Aristolochiaceae (p. 327)			
Santalales, Santalaceae (p. 328)....			

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